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West Corridor Bus Service Study

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West Corridor Bus Service Study

WESTBus

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Abstract

This report summarizes the results of a detailed examination of eleven bus routes that operate primarily in Newton, Waltham, and Watertown, including express service to and from downtown Boston. The study had four major objectives: (1) to ensure that service was as responsive to user needs as possible, (2) to identify changes that could attract new ridership, (3) to determine whether MBTA resources were being used as effectively as possible, and (4) to identify ridership and performance characteristics of each route.

For each route, the report includes a description of the route, an assessment of the existing service, identification and evaluation of service alternatives, and conclusions and recommendations. Included in the recommendations are changes with respect to route alignments, service levels, schedules, and reliability, and other changes within the corridor that would affect ridership. The report also includes a market analysis that examined overall travel and development patterns within the corridor. This analysis determined which segments of the overall market are served by the existing routes, identified major trip attractors and generators not being served, and determined the implications of development for existing and future bus service.

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West Corridor Bus Service Study
Executive Summary

Bus service in the WESTBus corridor involves eleven local and express routes in Allston-Brighton, Belmont, Dedham, Needham, Newton, Waltham, Watertown, and West Roxbury.[1] These routes, shown in Figure E-1, are as follows:

Local Routes

Route 52 Dedham Mall/Charles River Loop - Watertown Square
Route 53 Roberts - Newton Corner
Route 54 Waverley Square - Newton Corner
Route 56 Waltham Highlands - Newton Corner
Route 58 Auburndale - Newton Corner
Route 59 Needham Junction - Watertown Square

Express Routes

Route 300 Riverside - Downtown Boston
Route 301 Brighton Center - Downtown Boston
Route 302 Watertown Square - Copley Square
Route 304 Watertown Square/Newton Corner - Downtown Boston
Route 305 Waltham Center - Downtown Boston

In general, these routes serve an area that is difficult to serve with transit. There are no concentrated locations within the corridor that attract enough trips to support high levels of transit service, and there is a very low level of transit dependency. As a result, the transit dependent population comprises a very low transit base, and on local routes, low levels of service discourage most others from using transit.

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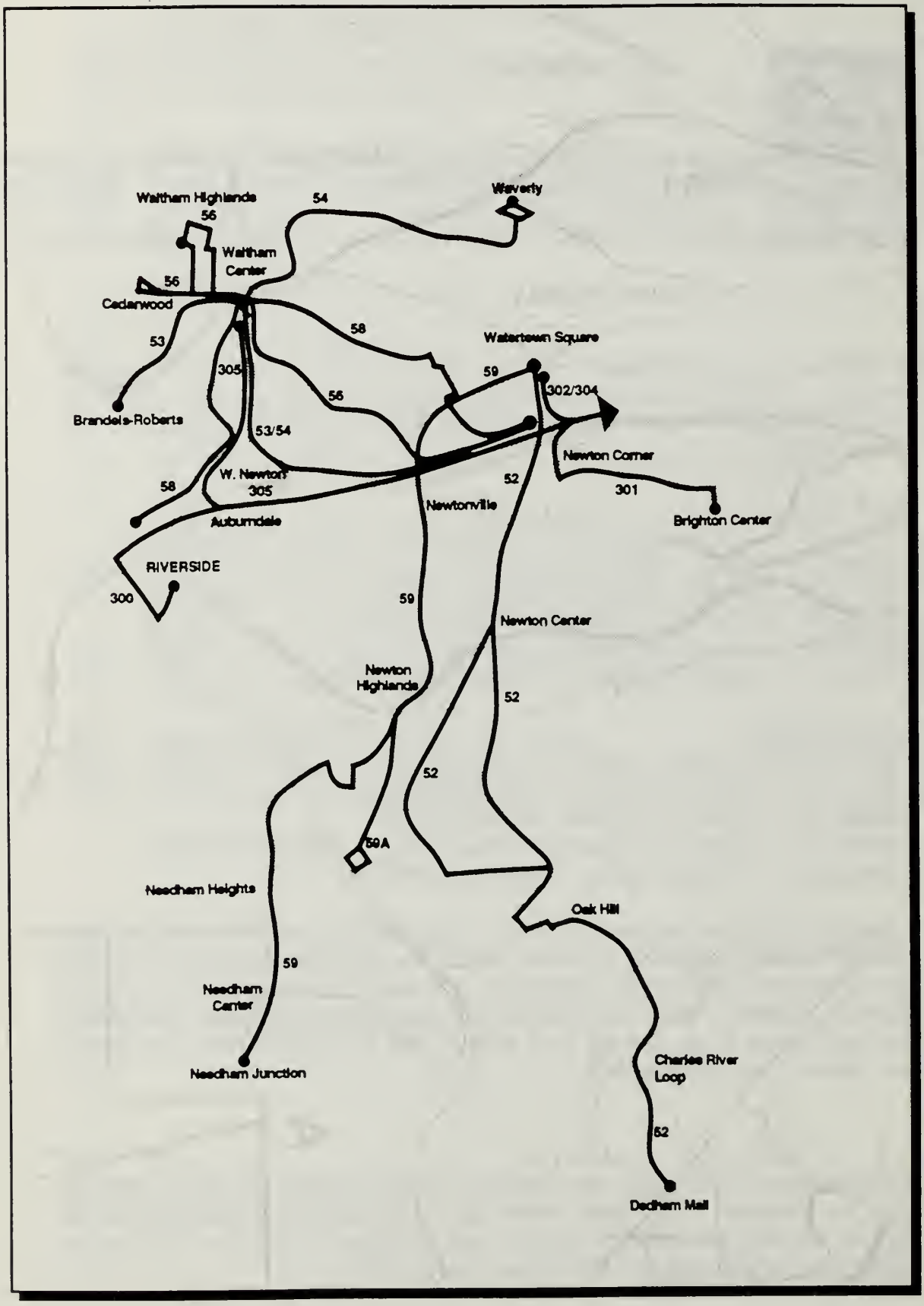
[1]A twelfth route, Route 57, also operates through part of the West Corridor, but is not included. This route, which operates parallel to Route 301 between Brighton Center and Newton Corner, was examined as part of the Central North Corridor Bus Study, CTPS report, April 1988).

Figure E-1
Map of WESTBus Routes



However, large numbers of trips are made from the WESTBus area to downtown Boston, and the express routes are successful in attracting a large percentage of these trips. The express routes, in contrast to local routes, serve very few transit dependent riders, and instead attract "choice" riders. Most peak period, peak direction express trips are at, close to, or exceed seated capacity, but mid-day and non-peak direction service is lightly utilized. As a result, the overall utilization of these routes, in terms of passengers per vehicle mile or per vehicle hour, is relatively low. However, since there are few transit dependent riders, average fares are high, and the express routes recover 60 to 90 percent of their operating costs.

For the foreseeable future, the number of trips made from the WESTBus area to downtown Boston will decline in relation to the total number of trips made from the WESTBus area, but they will continue to increase in absolute numbers. As a result, this market will continue to be the source of most WESTBus ridership, and also holds the potential for the most significant ridership increases.

Elsewhere, due to the scattered nature of trip attractors and generators, large increases in local ridership cannot be attained in a cost effective manner. Therefore, the major function of local routes will continue to be one of providing a basic level of service within the WESTBus area. In terms of cost reduction, there are a number of changes that can be made to individual local routes that would reduce costs, but most would result in ridership losses as well.

However, both local and express ridership could be increased and costs reduced by better integrating local and express services, and providing more of a focus on peak period service. In part, this would include changes to local routes to provide better connections with express routes, increased through-routing of local routes with express routes, and improved coordination between other existing local and express services. Such changes would include:

- Extend Route 302 from Copley Square to Federal and Franklin Streets to facilitate through-routing with local routes and provide service to Park Square.

- Through-route additional local trips operating through Waltham Center (existing Routes 53, 54, 56, and 58) to Boston with Route 302 or 304 trips at Newton Corner or Watertown Square.

- Coordinate departures and arrivals of through-routed local trips with Route 305 at Waltham Center.

- Through-route Route 59 with Route 302 at Watertown Square.

- Provide 30 minute peak period headways on all local routes (compared to current headways of 30 to 60 minutes).

The through-routing of local trips and the coordination of service at Waltham Center would allow many express trips to be shifted from Route 305 to underutilized local trips. The increased utilization of the local routes would then reduce the overall amount of service that must be provided to serve existing and projected demand. Further, since through-routed local trips can provide similar travel times between Waltham Center and downtown Boston as Route 305, Route 305 riders that were shifted to through-routed local trips would not experience a degradation in service. In addition, the through-routings and the extension of Route 302 through Park Square would provide greater access from more of the WESTBus area to more of Boston. The shifting of express riders to local routes would require that peak period service levels on local routes be increased slightly (to 30 minute peak period headways), which would benefit local riders as well.

Most changes could be implemented in either of two ways: (1) to minimize disruption to the existing system and travel patterns, or (2) to maximize benefits in terms of increased ridership and reduced operating costs. The first would involve more modest changes that would be easier to implement, at a cost of sacrificing maximum benefits. The second would achieve the greatest benefit to most existing riders and generate new ridership while reducing operating costs, but would also involve changes to existing travel habits, and leave some existing riders unserved. The changes that would be easiest to implement are described directly below as "Phase I Improvements"; the more significant changes follow those and are listed as "Phase II Improvements."

PHASE I IMPROVEMENTS

Changes that would be easiest to implement generally involve route changes that would not also affect other routes such as headway changes, the through-routing of existing routes, and schedule coordination. These would be as listed below and summarized in Table E-1:

Route 52 (Dedham Mall/Charles River Loop - Watertown Square)

- *Eliminate the Community Center variations (52.6 and 52.7).*

- *Increase mid-day headways from 30 minutes to 45 minutes.*

  On the Community Center variations, twenty-one daily bus trips are used by only 30 persons per day. These variations increase the

Table E-1
Summary of Phase I Changes

	New Pax Trips	Pax Trips Lost	Net Change	Annual Impact of Weekday Changes: Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost/ New Pax	Net Savings/ Pax Lost	Impact on AM Pk Veh Reqmt
PHASE I CHANGES									
Route 52 (Charles River Loop/Dedham Mall - Watertown Square)									
•Eliminate Community Center variations	65	60	5	($9,600)	($500)	($9,100)	($7.28)	NA	None
•45 min base hdways	0	60	-60	($59,000)	($6,500)	($52,500)	NA	$3.50	None
•Overall Impact	65	120	-55	($68,600)	($7,000)	($61,600)	NA	$4.48	None
Route 53 (Brandeis/Roberts - Newton Corner) and Route 54 (Waverly Square - Newton Corner)									
•40 Min PM peak headways									
Route 53	10	0	10	$0	$850	($850)	($0.34)	NA	None
Route 54	5	0	5	$0	$429	($429)	($0.34)	NA	None
•40 Min PM peak headways									
Route 53	55	0	55	$14,700	$4,675	$10,025	$0.73	NA	None
Route 54	50	0	50	$15,100	$4,290	$10,810	$0.86	NA	None
•Overall Impact	120	0	120	$29,800	$10,244	$19,556	$0.65	NA	None
Route 56 (Newton Highlands - Newton Corner)									
•Operate Rt 56.1 trips as Route 56.0 trips	25	5	20	$0	$1,800	($1,800)	($0.36)	NA	None
•Eliminate 3:00 PM inbound trip	0	0	0	($5,500)	$0	($5,500)	NA	NA	None
•30 Min PM peak headways	70	0	70	$5,500	$6,300	($800)	($0.05)	NA	None
•Overall Impact	95	5	90	$0	$8,100	($8,100)	($0.36)	NA	None
Route 58 (Auburndale - Newton Corner)									
•Relocate inner terminal to Watertown Sq and thru-route all trips with Route 304.0	50	20	30	$0	$2,700	($2,700)	($0.36)	NA	None
•Overall Impact	50	20	30	$0	$2,700	($2,700)	($0.36)	NA	None
Route 59 (Needham Junction - Watertown Square)									
•Eliminate Rt 59.1 variation	0	135	-135	($331,500)	($14,500)	($317,000)	NA	$9.39	None
•Thru-rt all trips with Rt 302	65	0	65	$0	$7,000	($7,000)	($0.43)	NA	None
•Overall Impact	65	135	-70	($331,500)	($7,500)	($324,000)	NA	$18.51	None
Route 300 (Riverside - Downtown Boston)									
•7.5 - 15 min PM peak headways	0	20	-20	($45,200)	($6,000)	($39,200)	NA	$7.84	None
•Overall Impact	0	20	-20	($45,200)	($6,000)	($39,200)	NA	$7.84	None
Route 301 (Brighton Center - Downtown Boston)									
•Add inbound trip at 8:08 AM to reduce crowding	0	0	0	$5,800	$0	$5,800	NA	NA	None
•Overall Impact	0	0	0	$5,800	$0	$5,800	NA	NA	None

Table E-1 (cont.)
Summary of Phase I Changes

	New Pax Trips	Pax Trips Lost	Net Change	Annual Impact of Weekday Changes: Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost/ New Pax	Net Savings/ Pax Lost	Impact on AM Pk Veh Reqmt
Route 302 (Watertown Square - Copley Square) and Route 304 (Newton Corner/Watertown Square - Downtown Boston)									
•Extend Rt 302 to Fed/Franklin; Eliminate Rt 304 mid-day	685	90	595	$94,900	$126,500	($31,600)	($0.21)	NA	+3
•Add two trips in AM peak half-hour on Rt 304.0 to reduce crowding	0	0	0	$24,900	$0	$24,900	NA	NA	+1
•Add one trip in PM peak half-hour on Route 304.0 to reduce crowding	0	0	0	$12,400	$0	$12,400	NA	NA	None
•Overall Impact	685	90	595	$132,200	$126,500	$5,700	$0.04	NA	+4
Route 305 (Waltham Center - Downtown Boston)									
•Integrate Route 305 service with thru-routed local routes	230	90	140	$29,800	$52,500	($22,700)	($0.65)	NA	-2
•Overall Impact	230	90	140	$29,800	$52,500	($22,700)	($0.65)	NA	-2
TOTAL PHASE I IMPACTS	**1,310**	**480**	**830**	**($247,700)**	**$179,544**	**($427,244)**	**($2.06)**	**NA**	**+2**

complexity of the route, increase headways or trip times for passengers traveling on the major variations of the route beyond Newton Centre, and require that 30 minute headways be provided during the mid-day, which is more service than demand warrants.

The elimination of these variations would allow the overall level of service provided on Route 52 to be reduced. During the PM peak, the Community Center variations should be replaced by Route 52.1 trips to serve demand along the trunk portion of the route, but during the mid-day, a lower level of service could be provided. Currently, during the mid-day, Route 52.1 and 52.7 trips both operate at 60 minute headways and alternate trips. With the elimination of Route 52.7, Route 52.1 should operate at 45 minute headways. One fewer vehicle would be required during the base and school periods, and the annual operating deficit would be reduced by approximately $61,600.

Route 53 (Brandeis/Roberts - Newton Corner) and Route 54 (Waverley - Newton Corner)

- *Operate both routes at 40 minute peak period headways*

Routes 53 and 54 serve the same alignment between Waltham Center and Newton Corner. Presently, irregular headways are operated in the AM peak, averaging 38 minutes on Route 53 and 48 minutes on Route 54, with most service concentrated between 6:50 AM and 7:45 AM. Actual headways on the trunk range from 10 to 25 minutes. Existing ridership does not warrent the concentration of service between 6:50 and 7:45 The same amount of service could be better utilized by operating even 40 minute headways throughout the period on each route, resulting in 20 minute headways on the trunk portion of the route throughout the AM peak. This change could be implemented at no cost and without any change in vehicle requirements.

During the PM peak, service on both routes operates at 60 minute headways, resulting in 30 minutes on the trunk. Most riders walk to the route at the outer end, but over half transfer to another bus at the inner end. As a result, riders are able to time their arrival to the route in the AM peak more precisely than in the afternoon, so that most mode choice decisions are probably governed more by the 60 minute PM peak headway than by the shorter AM peak headways. In this case, a reduction in PM peak headways to match AM peak headways should also result in corresponding ridership increases in the AM peak.

To provide 40 minute headways in the PM peak would require the deployment of two additional vehicles at a cost of approximately $29,800 per year. With headways set at 40 minutes during both periods, ridership would increase by up to 135 trips per day.

Route 56 (Waltham Highlands - Newton Corner)

- *Operate the two Route 56.1 trips as Route 56.0.*

- *Eliminate the 3:00 PM inbound trip.*

- *Add one trip in the PM peak to provide 30 minute headways to match AM peak headways.*

Only five passenger trips per day are made on the segment of Route 56.1 beyond Main Street to Cedarwood. This service could be used more productivly as Route 56.0 service and the route would be simplified. The Cedarwood area would continue to be served by Route 70. This change would have no cost impact.

During the mid-day, service operates at 60 minute headways with the exception of an extra inbound school trip at 3:00 PM. This additional trips carries only four passengers and is not needed. The elimination of this trip would save $5,410 per year.

In the PM peak, headways average 45 minutes. By adding one trip, headways could be reduced to 30 minutes to match AM peak headways. The rationale for this change would be the same as with Routes 53 and 54. Approximately 70 additional trips would be attracted. The $5,500 annual cost of the additional trip should be offset by additional fare revenue.

Route 58 (Auburndale - Newton Corner)

- *Change Route 58's inner terminal from Newton Corner and through-route all trips with Route 302 or 304.0.*

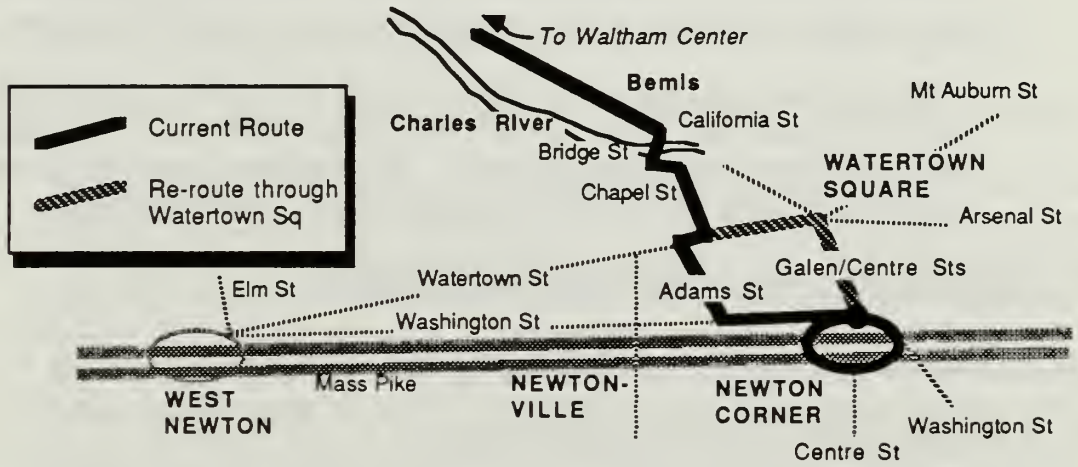
By relocating Route 58's inner terminal from Newton Corner to Watertown Square as shown in Figure E-2, it would then be possible to through-route all Route 58 trips with Route 304.0 (as compared to the seven that are now through-routed with Route 304.1). As long as all trips were though-routed, Newton Corner would continue to be served, transfers would be eliminated for Boston-bound riders and new riders would be attracted to through-routed service. This change

could be implemented at no cost to eliminate 50 transfers per day and attract a net increase of approximately 30 new trips per day.

Route 59 (Needham Junction or Newton City Line - Watertown Square)

- *Eliminate the Route 59.1 variation which operates between the Newton City Line and Watertown Square. Operate Route 59.0 at 30 minute peak period headways, and 60 minute mid-day headways.*

Figure E-2
Re-routing of Route 58's Inner Terminal



- *Through-route all Route 59.0 service with Route 302 at Watertown Square with Route 302.*

Ridership on the Route 59.1 variation is extremely low, carrying only 45 trips per day past Newton Highlands, while Route 59.0 at the headways described above could accommodate the other 155 riders that only use the segment of Route 59.1 between Newton Highlands and Watertown Square. This change would save $317,000 per year.

Connections to Boston could be improved by through-routing all Route 59 trips with a Route 302 trip. The through-routed service would be somewhat indirect but still faster than a transfer and would provide a one-seat ride to Boston. The through-routing could be accomplished at no cost, eliminate 20 daily transfers and attract 65 new trips.

Route 300 (Riverside - Downtown Boston)

- *Deploy older buses with higher seating capacities on Route 300 in the AM peak.*

- *Increase PM peak headways between 4:40 PM and 5:45 PM from an average of 6 minutes to 7.5 minutes, and before and after that time from 10 to 15 minutes.*

  During the AM peak, peak loads average 47 to 49. As a result, most passengers could be provided with a seat by deploying older buses with seating capacities of 46 or more. Without this change and the deployment of newer RTS II buses with seating capacities of 40, there would be seven to nine standees per trip, or to eliminate standees, three additional trips would be needed at a cost of $42,200 per year.

  In the PM peak, peak loads average only 29 throughout the period, and 38 in the peak half-hour. As a result, headways could be increased without forcing passengers to stand. The headway increases described above would save $46,200 per year and require two fewer buses.

Route 301 (Brighton Center - Downtown Boston)

- *Add an inbound trip at 8:08 AM to relieve crowding.*

- *Operate Route 301.1 trips as Route 301.0*

  During the AM peak, inbound trips depart at four minute intervals except for an eight minute gap between 8:04 AM and 8:12 AM. The eight minute gap results in loads of approximately 74 passengers on the 8:12 AM trip.

  Route 301.1 trips, which operate only during the afternoon, travel inbound from Brighton Center via Newton Corner. Ridership on all inbound trips is very low, at less than four passengers per trip, and these passengers are also served by Route 301.0 service, which operates inbound via Union Square. Since the outbound trips are needed, Route 301.1 trips could not be eliminated, but fewer vehicles would be required by operating these trips instead as Route 301.0.

  Further, Route 301 experiences reliability problems in both peak periods due to insufficient cycle times. With the continuation of the current routings, necessary increases in cycle times would increase operating costs by $48,200 and increase vehicle requirements by one in the AM peak and by two in the PM peak. Operation of all Route 301.0

and 301.1 trips as 301.0 trips would solve reliability problems without increasing operating costs or vehicle requirements.

Route 302 (Watertown Square - Copley Square) and
Route 304 (Watertown Square - Federal and Franklin Streets

- *Extend Route 302 from Copley Square to Federal and Franklin Streets via Park Square along the alignment previously used by Route 310.*
- *Eliminate the loop around the Prudential Center.*
- *Return Route 302 mid-day service to 30 minute headways.*
- *Eliminate Route 304.0 service between 9:10 AM and 3:40PM.*
- *Add two trips in AM peak half-hour on Rt 304.0 to reduce crowding.*
- *Add one trip in PM peak half-hour on Route 304.0 to reduce crowding.*

An extension of Route 302 to Federal and Franklin Streets via Park Square would increase ridership by 595 trips per day and allow for the elimination of mid-day Route 304.0 service. With the elimination of the loop around the Prudential Center, local trips through-routed with Route 302 could provide comparable service between downtown Boston and Waltham Center in terms of travel time, while existing riders would still be within walking of the Prudential Center. The return of Route 302 to 30 minute headways would be necessary to fully replace Route 304.0 service. The overall cost impact would be an operating cost increase of $94,900 per year coupled with an increase in fare revenue of $126,500 for a decrease in the operating deficit of $31,600.

Route 305 (Waltham Center - Downtown Boston)

- *Through-route all peak period local service on Routes 53, 54, 56, and 58 to Boston with Route 304 or 302 and coordinate through-routed local services with Route 305.*
- *Increase peak period headways from 10 to 15 minutes.*

With the through-routing of the local routes and the coordination of services at Waltham Center, up to 290 peak period passenger trips would shift from Route 305 to through-routed local trips on Routes 53, 56 and 58. This would allow Route 305 headways to be increased to 15

minutes. This would result in a decrease in the number of peak period peak direction trips on Route 305 from 29 to 18, while the total number of direct trips to Boston, including the through-routed trips, would increase from 49 to 50.

Routes 53, 54, 56, 58 and 305 would be scheduled to provide service to downtown Boston at five minute intervals. A typical sequence of trips from Waltham Center (at five minute intervals) would be Route 305, 58/302, 54/304.1, 305, 56/304.1, 53/304.1, 305, 58/302, and so forth. The impact of this change would be a net ridership increase of 140 trips per day, a savings of one vehicle in the AM peak, and a reduction in the annual operating deficit of $22,700.

Summary of Phase I Changes

In total, Phase I changes would increase ridership by 830 trips per weekday, or 5.4 percent, while at the same time reducing annual operating costs by $247,700 and the operating deficit by $427,240. AM peak vehicle requirements would increase by two.

PHASE II IMPROVEMENTS

Additional savings could be realized by implementing more significant changes to eliminate or reduce service levels on duplicative and/or unproductive services, and by a more comprehensive integration of local and express services. In many respects, express and local services now exist as two separate systems serving two different types of riders. Express routes provide a high level of service, and are well utilized, while WESTBus local routes provide a low level of service and are underutilized. In general, express riders are affluent and ride express service instead of driving by choice, whereas most local riders have relatively low incomes for the WESTBus area and ride the bus because they do not have a car available.

Based on present service configurations, the disparity between the levels of service provided on the two different types of routes is justified by the different levels of demand for the two types of service. However, some of this disparity could be eliminated by increasing the use of through-routed local service for trips to Boston, and by allowing local trips to be made on express routes (as is done elsewhere in the MBTA system). In effect, this would allow many express trips to be combined with local trips, with one combined bus trip providing the same amount of service as separate express and local trips. This, in turn, would allow more of both types of service to be provided with fewer resources.

Further, by coordinating all Boston service operating at or through Waltham Center, Watertown Square and Newton Corner, an extremely high level of service could be provided to and from Boston during peak periods from three locations in the WESTBus area. (Although a high level of service is already provided from these locations, the through-routing of all local trips on specific routes and improved coordination of services could increase service levels at all three locations.) At Waltham Center, average headways to and from Boston would be five minutes during both peak periods, at Watertown Square they would be five minutes in the AM peak and eight minutes in the PM peak, and at Newton Corner, headways would be three to four minutes during both peak periods.

Phase II changes would include:

- The through-routing of all local service, except Route 52, with Route 302 or 304 service.
- Shorter peak period headways on through-routed local routes
- Longer mid-day headways on local routes.
- The elimination of Route 58 service beyond Waltham Center. (Instead allow local trips on Route 305.)
- The elimination of Route 54 between Waltham Center and Newton Corner. (The same alignment is also served by Route 53.)
- The combination of the remaining segments of Routes 54 and 58 into one route operating between Newton Corner/Watertown Square and Waverley Square.
- Coordination of the revised routes with existing local and express routes at Waltham Center, Newton Corner and Watertown Square on an all day basis.

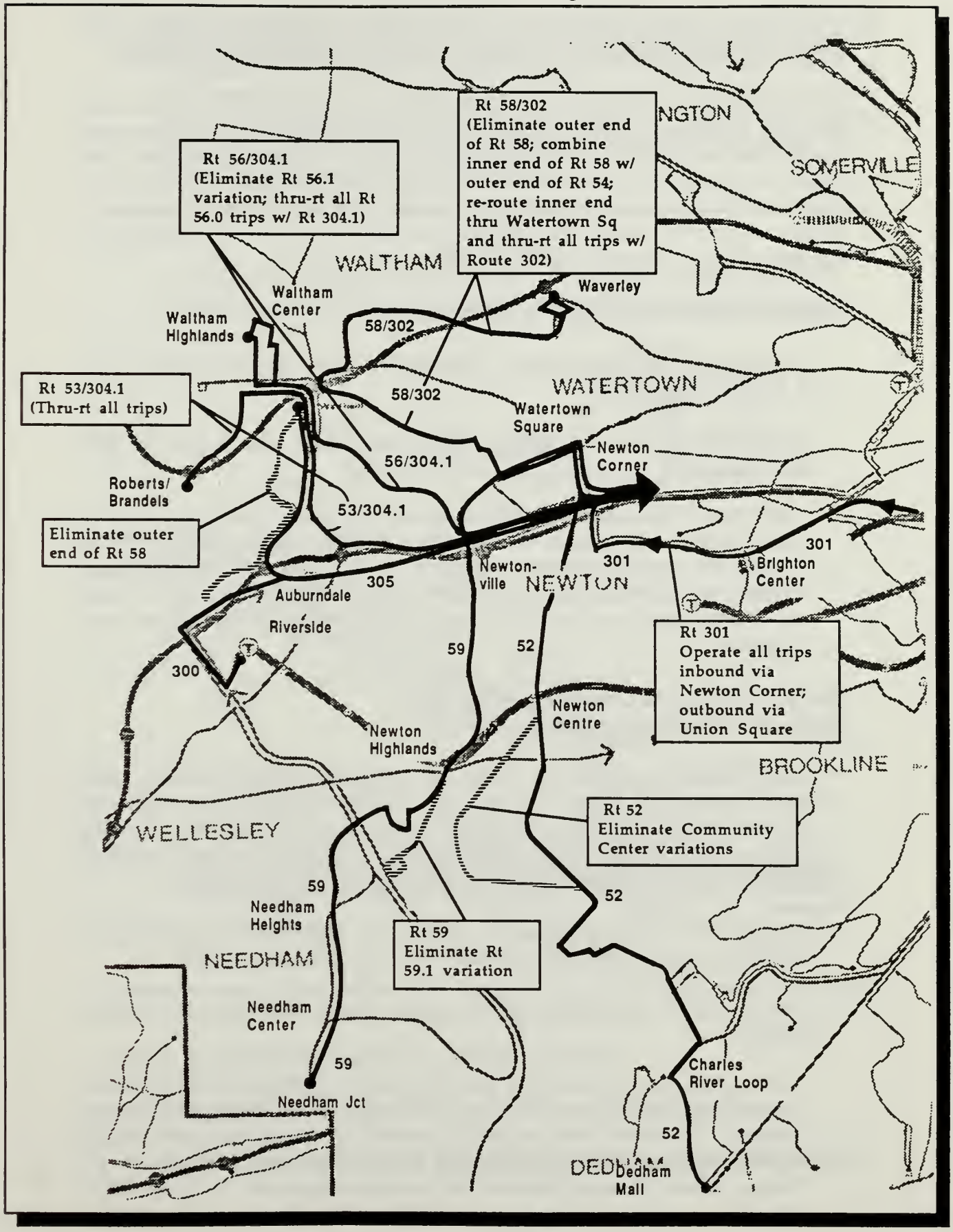
These more significant changes would decrease operating costs by another $322,600 and attract an additional 985 daily passangers beyond those possible in Phase I. Including the additional revenue generated by these new riders, the operating deficit could be reduced by an additional $408,410.

In more detail, proposed changes and impacts would be as follows (see also Table E-2 and Figure E-2).

Table E-2
Summary of Phase II Changes

	Annual Impact of Weekday Changes								
	New Pax Trips	Pax Trips Lost	Net Change	Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost/ New Pax	Net Savings/ Pax Lost	Impact on AM Pk Veh Reqmt
PHASE II CHANGES (Impacts over and above those of Phase I)									
Route 53 (Brandeis/Roberts - Newton Corner) and Route 54 (Waverly Square - Newton Corner)									
•15 min peak period hdwys on Rt 53 to allow for elimination of Rt 54 between Wal Ctr & Newton Cnr	205	0	205	$87,500	$18,156	$105,656	$2.06	NA	+3
•Combine inner end of Rt 58 w/ outer end of Route 54 and eliminate inner end of Rt 54 between Wal Ctr & Newton Cnr (see also Route 58)	0	140	-140	($88,000)	($11,900)	($76,100)	NA	$2.17	-2
•Overall Impact	205	140	65	($500)	$6,256	($6,756)	($0.42)	NA	+1
Route 56 (Waltham Highlands - Newton Corner)									
•Thru-rt all trips w/ Rt 304.1	25	0	25	$0	$2,250	($2,250)	($0.36)	NA	None
•Overall Impact	25	0	25	$0	$2,250	($2,250)	($0.36)	NA	None
Route 58 (Auburndale - Newton Corner)									
•Eliminate Rt 58 beyond Wal Ctr and operate along outer end of Route 54	0	115	-115	($83,400)	($10,500)	($72,900)	NA	$2.54	None
•Overall Impact	0	115	-115	($83,400)	($10,500)	($72,900)	($2.54)	NA	None
Improved Integration of Local and Express Services									
•Integrate local and express service at Wal Ctr, Newton Cnr & Wat Sq (in addition to Rt 53 and 305 changes already described above)	1,150	140	1,010	($238,700)	$87,800	($326,500)	($1.29)	NA	-1
•Overall Impact	1,150	140	1,010	($238,700)	$87,800	($326,500)	($1.29)	NA	-1
TOTAL PHASE II IMPACTS	**1,380**	**395**	**985**	**($322,600)**	**$85,806**	**($408,406)**	**($1.66)**	**NA**	**None**
PHASE I + PHASE II IMPACTS	**2,690**	**875**	**1,815**	**($570,300)**	**$265,350**	**($835,650)**	**($1.84)**	**NA**	**+2**

Figure E-2
Recommended Route Changes



1. COORDINATION OF SERVICE AT WALTHAM CENTER/ INCREASED USE OF LOCAL SERVICE TO CARRY TRIPS TO AND FROM BOSTON

To maximize cost savings and ridership gains, all local routes operating through Waltham Center should be through-routed to Boston and coordinated with Route 305 at Waltham Center. Since all Waltham local routes now terminate at Newton Corner and nearly all Route 304.1 trips at Newton Corner are already through-routed with a local trip, changes to some local routes would be needed in order to increase the amount of through-routing. These changes would be as follows:

Route 53 (Roberts/Brandeis - Newton Corner)

- *No change to basic alignment. Through-route all trips with Route 304.1 at Newton Corner.*

- *Operate Route 53 at 15 minute peak period headways, 60 minute mid-day headways.*

  With the elimination of Route 54 (as described below), Route 53 headways would need to be shortened during peak periods to replace Route 54 service between Newton Corner and Waltham Center. During the mid-day, 60 minute headways would be sufficient to carry all of the trips now carried on both Route 53 and 54 along the same segment.

Route 54 (Waverley - Newton Corner) and
Route 58 (Auburndale - Newton Corner)

- *Combine outer segment of Route 54 beyond Waltham Center with inner segment of Route 58 (between Waltham Center and Newton Corner) (see Figure E-3). Eliminate Route 54 service between Waltham Center and Newton Corner and Route 58 service between Waltham Center and Auburndale.*

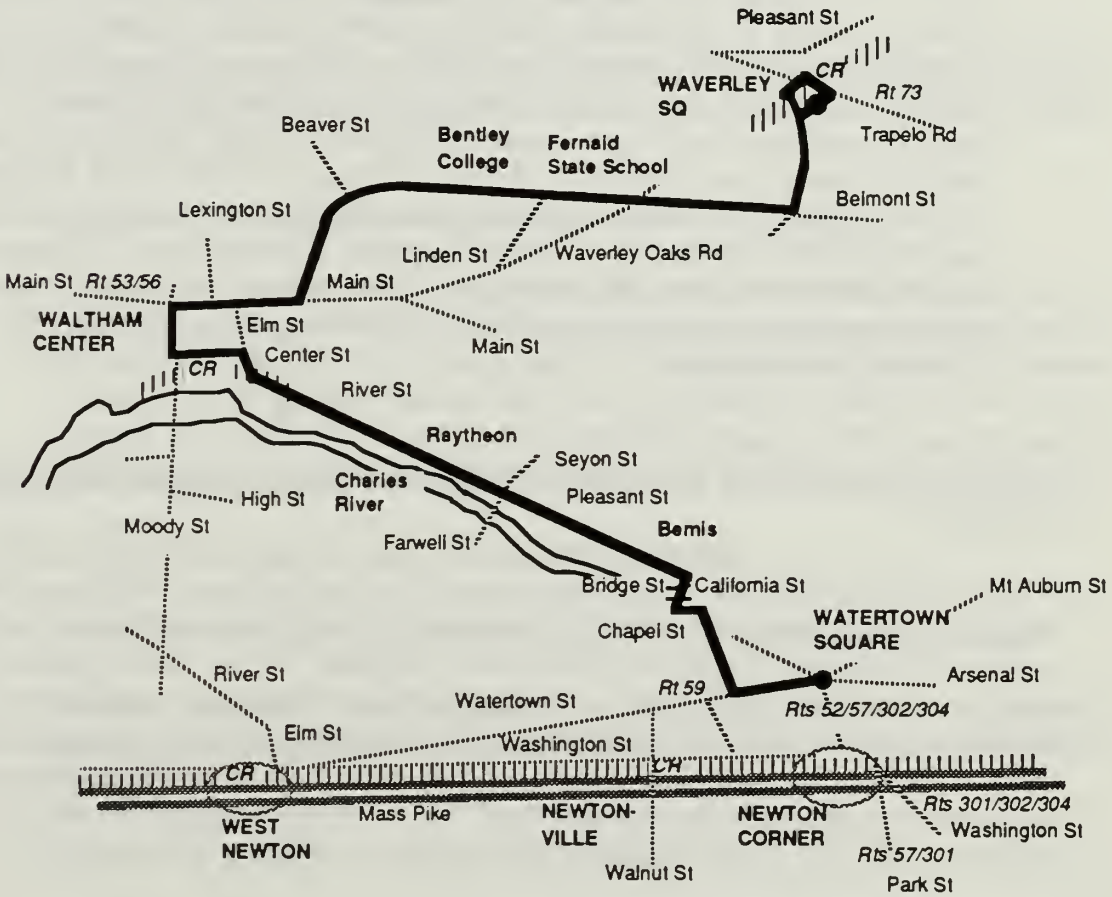
- *Reroute the inner terminal of Route 58 from Newton Corner to Watertown Square and through-route all trips with Route 302.*

- *Operate revised route at 30 minute peak period headways; 60 minutes mid-day.*

  These changes to Routes 54 and 58 would combine the two current routes into one route and allow all trips to be through-routed to Boston. The new route (called Route 58 for these purposes) would operate between Watertown Square along Watertown Street to Chapel Street, where it would follow the current alignment of Route 58 to

Waltham Center, and then the existing alignment of Route 54 from there to Waverley Square. Unproductive service along the outer end of Route 58 (between Waltham Center and Auburndale) would be eliminated, but most existing riders would still be within one-quarter of a mile of other service on Routes 53 and 305. Along the existing inner end of Route 54, equivalent service would be provided by Route 53, which follows the same alignment.

Figure E-3
Combination of Inner End of Route 58 and Outer End of Route 54, including Relocation of Inner Terminal to Watertown Square



Route 56 (Waltham Highlands - Newton Corner)

- *Through-route all trips with Route 304.1 at Newton Corner.*
- *Operate route at 30 minute peak period headways; 60 minutes mid-day.*

Route 305 (Waltham Center - Downtown Boston)

- *Through-route all local service on Routes 53, Route 56, and the revised Route 58 to Boston with Route 304 or 302 and coordinate through-routed local services with Route 305.*

- *Increase peak period headways from 10 to 15 minutes.*

With the through-routing of the local routes and the coordination of services at Waltham Center on an all day basis, up to 450 peak period passenger trips would shift from Route 305 to through-routed local trips on Routes 53, 56 and 58. This would allow Route 305 headways to be increased to 15 minutes, and the number of daily Route 305 trips to be reduced by 18. Routes 53, 56, 58 and 305 would be scheduled to provide service to downtown Boston at five minute intervals. A typical sequence of trips from Waltham Center (at five minute intervals) would be Route 305, 58/302, 53/304.1, 305, 56/304.1, 53/304.1, 305, 58/302, and so forth. Including the through-routed trips, the total number of trips to and from Boston would increase from 127 per day to 145. However, since the additional direct service would be provided by connecting existing routes, the "new" express trips would not involve cost increases.

2. IMPROVED SERVICE FROM NEWTON CORNER AND WATERTOWN SQUARE

With the increased use of through-routed local trips from Waltham, there would be an increased number of passengers already on-board buses as they arrive at Newton Corner or Watertown Square. This would leave less room on board for those that now board at those locations. In addition, the extension of Route 302 to Federal and Franklin Streets would also increase loads. To handle these increased loads, it would be necessary to provide additional service on Routes 302 and 304. These changes would be as follows:

Route 302 (Watertown Square - Copley Square)

In addition to the changes described in Phase I:

- *Increase the number of AM inbound trips from 11 to 22, with 19 operating at seven to eight minute headways throughout the period, and an additional three trips added during the peak half hour. Four of the 22 trips would be through-routed with Route 58 and four would be through-routed with Route 59.*

- *During the mid-day, return Route 302 to 30 minute headways.*

- *During the PM peak, increase the number of outbound trips from nine to 16. Headways would average eight to nine minutes .*

  During the AM and PM peaks, the additional trips would be needed to carry increased loads to and from the through-routed trips and Park Square. During the mid-day, thirty minute headways would be needed to carry ridership to Park Square and those trips now carried on Route 304.0, which would be eliminated.

Route 304.0 (Watertown Square - Downtown Boston)

- *Increase the number of AM peak inbound trips from 17 to 22, with Route 304.0 trips departing from Watertown Square at the same time as Route 302 trips.*

- *Continue to operate 15 outbound trips in the PM peak.*

  To prevent overcrowding on Route 302 trips, it would be necessary to operate peak period Route 304.0 trips on the same peak direction schedule as Route 302. Therefore, to a large extent, Route 302 service levels would govern Route 304.0 service levels. The one exception would be a 4:55 PM outbound Route 302 departure that would not be matched with a Route 304.1 departure.

Route 304.1 (Newton Corner - Downtown Boston)

- *Increase the number of inbound trips in the AM peak from 10 to 13.*

- *Continue to operate mid-day service at 30 minute headways. Alternate these trips with Route 302 trips, (which would also operate at 30 minute headways).*

- *Increase the number of outbound departures from 13 to 14.*

  All Route 304.1 trips throughout the day would be through-routed with a Route 53 or Route 56 trip. Schedules would be coordinated in both Waltham Center and Newton Corner.

Summary of Phase II Changes

With the changes at Waltham Center, Newton Corner and Watertown Square, a higher level of service would be provided during peak periods on most local services, and between the three locations and Boston. Most of the

new ridership would be attracted by this additional direct service to downtown Boston, and the additional peak period local service that would be one of the results of service coordination. Between Waltham Center and Boston, there would be an increase of 43 daily one-way trips, from 163 to 211. Between Newton Corner and downtown Boston, including Route 302, there would be an increase from 125 trips to 167 trips per weekday, and from Watertown Square, there would be an increase from 163 trips to 211 trips per day.[2] On local routes,there would also be an increase in peak period trips from 70 to 75 trips per weekday.

These increases could be achieved in conjunction with reduced costs by eliminating duplicative service and revising the remaining services to serve more than one market (i.e. local and express, and Waltham Center and Newton Corner and/or Watertown Square). Including both Phase I and Phase II improvements, total operating costs would be reduced by $570,300 per year, while fare revenue would increase by $265,350. The operating deficit would decrease by $835,650 per year. AM peak vehicle requirements would increase by two.

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[2]Many of the Newton Corner and Watertown trips, as well as the local trips, would be the same trips that originated in or were destined to Waltham Center.

1. Introduction

OVERVIEW

The West Corridor Bus Service Study is one of a series of bus studies commissioned by the MBTA to examine existing bus service to determine whether available resources are being used as effectively as possible. Specifically, this study examines the effectiveness of current bus service on eleven local and express routes in Allston-Brighton, Belmont, Dedham, Needham, Newton, Waltham, Watertown, and West Roxbury. These routes, shown in Figure 1-1, are as follows:

Local Routes

Route 52 Dedham Mall/Charles River Loop - Watertown Square
Route 53 Roberts - Newton Corner
Route 54 Waverley Square - Newton Corner
Route 56 Waltham Highlands - Newton Corner
Route 58 Auburndale - Newton Corner
Route 59 Needham Junction - Watertown Square

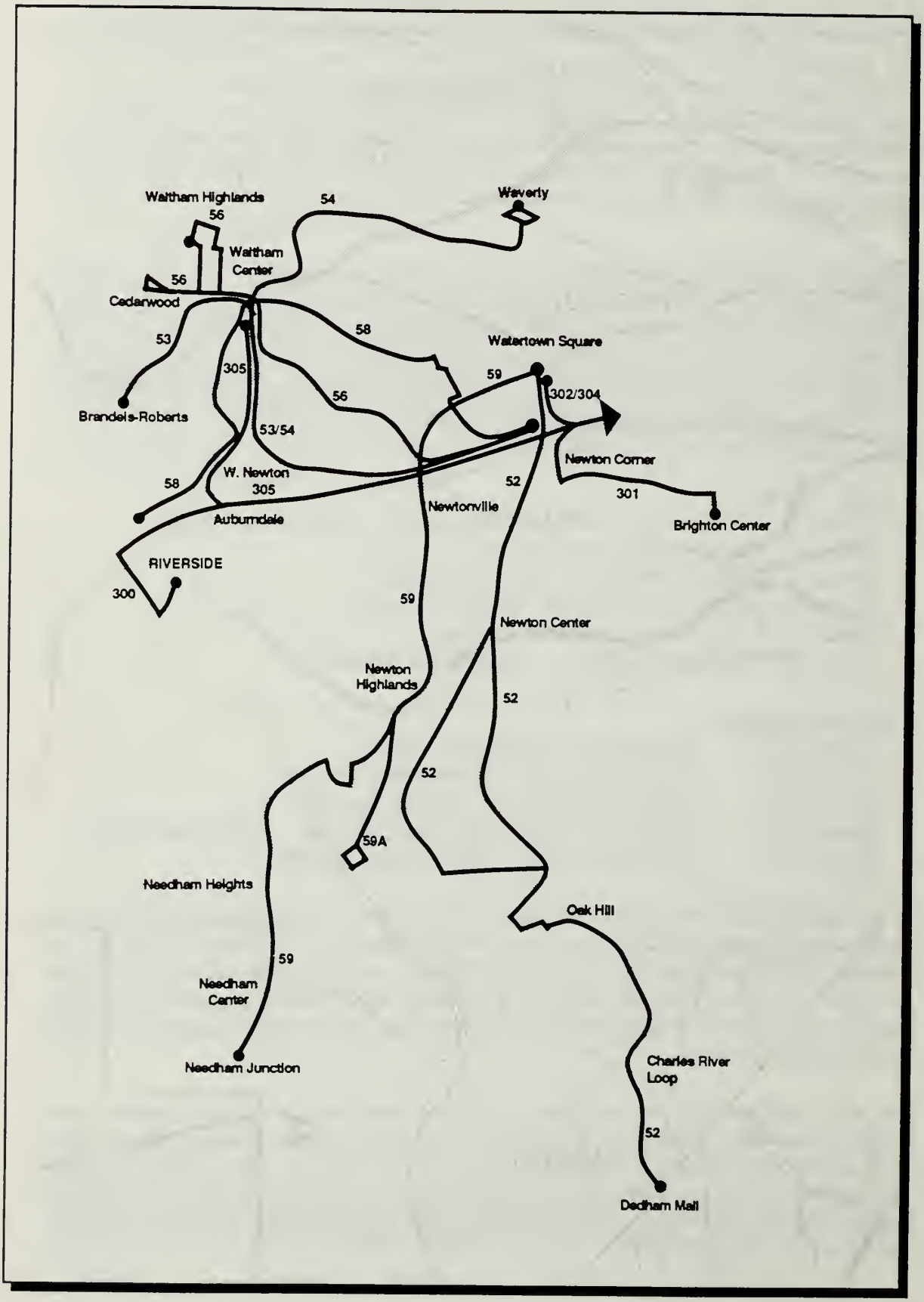
Express Routes

Route 300	Riverside - Downtown Boston
Route 301	Brighton Center - Downtown Boston
Route 302	Watertown Square - Copley Square
Route 304	Watertown Square/Newton Corner - Downtown Boston
Route 305	Waltham Center - Downtown Boston

In general, although many of the local routes are through-routed with express routes and most local and express routes intersect at Newton Corner or Watertown Square, the two groups of routes are distinctly different in most respects. The local routes serve low density suburban areas with relatively low levels of service, ridership is low, and the population served is heavily transit dependent.

On the express routes, service is focused around the peak periods and frequent service is provided. On only two of these routes, Routes 302 and 304, is mid-day service also provided. Most riders on these routes, in contrast to the local routes, are not transit dependent, and choose to ride the MBTA instead of driving. For the most part, peak period, peak direction trips on

Figure 1-1
Map of WESTBus Routes



express routes are full or nearly full (in terms of seated capacity), but reverse commute trips are lightly utilized.

In addition to the WESTBus routes, the area is served by the Riverside branch of the Green Line and three commuter rail rail lines: the Fitchburg line to North Station, and the Framingham and Needham lines to South Station. Also, Route 57, which was examined as part of the Central North Corridor Bus Study,[1] operates parallel to Route 301 between Brighton Center and Newton Corner.

STUDY PROCESS

This study examines the eleven bus routes from two primary perspectives: (1) how well the route performs when considered alone, and (2) its effectiveness within the overall system. This process involved a number of steps:

- Data collection
- Market analysis
- Assessment of existing service
- Identification of service alternatives
- Evaluation of alternatives
- Conclusions/recommendations

Data Collection

Data collection for the WESTBus study involved six major elements: (1) field checks to determine/verify stop locations and route mileages, (2) ridechecks, (3) pointchecks, (4) on-board passenger surveys, (5) collection of demographic information, and (6) service statistics and cost information. This information was collected over a four month period between April and July 1986.

The ridechecks and pointchecks were conducted to obtain detailed ridership and bus running time and schedule adherence information. With the exception of Route 300, all of this information was collected through ridechecks. On Route 300, there were few enough stops so that the same information could be collected by pointchecks. The pointcheck data was also supplemented by additional ridechecks on Route 300. In total, 404 local runs, and 592 express runs were ridechecked and/or pointchecked, resulting in sample sizes of 173 percent for local routes, and 122 percent for express routes.

The passenger surveys were distributed on board buses in May and June of 1986. These surveys requested information on the trip being made, socio-economic data, and an assessment of the quality of the service provided. In

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[1]Central North Corridor Bus Study, CTPS report, July 1988.

total, 2100 surveys were distributed on 146 bus trips (20 percent of the daily total). Approximately 85 percent of all passengers accepted the surveys, and 76 percent were returned useable.

Demographic and development data were collected in order to analyze the market served by WESTBus routes. The primary data sources used were 1980 U.S. Census journey-to-work data, and development data produced by the Metropolitan Area Planning Council (MAPC) and the individual cities and towns.

Bus service statistics and cost information are based on information supplied by the MBTA. All operating costs and fare revenues are in 1986 dollars, but service statistics have been updated to Winter 1988. These statistics are the same for all routes as they were in the Spring of 1986 except on Route 302, where AM peak headways were reduced from 12 to 10 minutes, and mid-day headways increased from 30 minutes to 60 minutes in the Summer of 1987. The ridership impacts of these changes are not yet known.

Market Analysis/Assessment of Existing Service

Based on the data described above, general socio-economic and travel characteristics of all residents of the WESTBus area were matched with similar characteristics of WESTBus riders. This provided information on which segments of the overall WESTBus market were being served by WESTBus routes, and identified major trips attractors and generators not being served. Development projections provided information on how well existing routes could serve planned development, and where new service may be needed in the future.

Identification and Evaluation of Alternatives for Improved Service

Based on the market analysis and the assessment of each individual route, a number of alternatives were developed for each route. These alternatives addressed:

- Ridership, including overall ridership and ridership by segment, transfers and passenger loads.

- Route Alignments, based on how well each route's alignment serves area residents and other nearby trip attractors and generators. Changes examined include minor re-routings, route extensions, major changes that could significantly alter the character of a route, route combinations, and increased through-routing of local and express routes.

- Reliability, including on-time performance at the beginning of and along the route, and the impact on transfers. Alternatives examined include changes to cycle times, deployment of additional vehicles, and holding strategies.

- Schedules - how schedule changes would impact route productivity, passenger convenience and wait time, passenger loads, and travel times.

The evaluation of these alternatives involved the impact on the MBTA and its passengers. Of primary concern was the impact on the MBTA operating deficit, vehicle requirements, the attraction of new ridership, and the impact on existing riders in terms of wait time and overall travel time.

Conclusions/Recommendations

Many of the service changes discussed in the report would either reduce costs at the expense of ridership, or require increased expenditures to increase ridership. However, there are also a number of changes that could both reduce costs and increase ridership. While all possible changes and their impacts are summarized in the final chapter, the final recommendations are largely based upon the latter type of service changes and are intended to represent a balance between the goals of reducing costs and increasing ridership.

ORGANIZATION/ADDITIONAL INFORMATION

The following sections summarize the major findings, conclusions and recommendations of the WESTBus Study. More detailed information specific to individual routes and comparison data on all routes is contained in two separately bound documents: Technical Supplement 1 and Technical Supplement 2. The contents of these supplements is included in the Table of Contents for this report. In general, Technical Supplement 1 contains descriptive route information, ridership, service and performance data, and financial data. Technical Supplement 2 summarizes the passenger survey, 1980 U.S. Census journey-to-work data pertinent to the corridor, and provides schedule statistics for each of the routes.

2. Market Analysis

GENERAL STUDY AREA CHARACTERISTICS

The WESTBus "corridor" consists of the areas in Boston, West Roxbury, Belmont, Waltham, Watertown, Newton, Needham and Dedham shown in Figure 2-1. As indicated, the eastern portions of Belmont, Watertown and West Roxbury are included, as well as parts of Allston and Brighton. Due to the large size of many of these areas, most were subdivided in order to achieve a more appropriate level of detail for analysis purposes. These subdivisions are also shown in Figure 2-1.[2]

Belmont	- Only the Waverley Square area is included.
Boston	- South Allston/Brighton and West Roxbury.
Dedham	- Not sub-divided.
Needham	- Not sub-divided.
Newton	- North, South, East and West.
Waltham	- Central, North and South.
Watertown	- West and South.

With respect to WESTBus express bus service, the subdivisions used at the Boston end are shown in Figure 2-2.

Population/Employment

In 1980, the total population of this area, according to the U.S. Census, was 267,590 persons, representing 4.7 percent of the state's population. This represents a decline of almost 11 percent between 1970 and 1980. However, since 1980, population has stabilized, declining only 1.1 percent through 1987. Modest declines of 0.2 percent per year are expected to continue through 1990.

Although population has declined, employment has been increasing and is projected to continue to increase. Employment in the study area has increased from 154,900 jobs in 1980 to 170,300 jobs by 1985, a gain of 17 percent.

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[2]Where sections of towns or cities coincided with the similar demarcations used in other corridor studies (such as the Central North corridor), the same areas and names were used.

Figure 2-1
Map of WESTBus Area

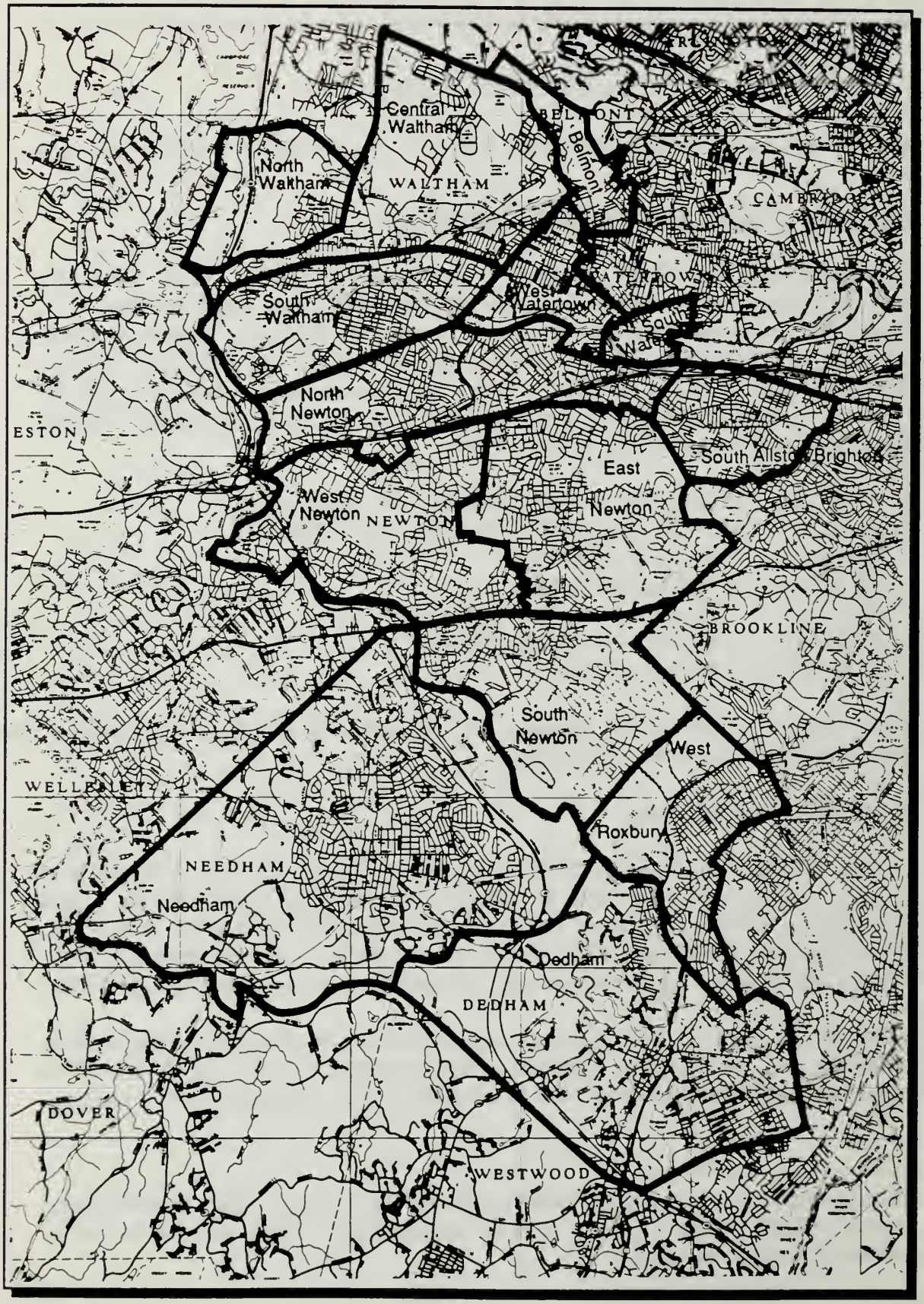
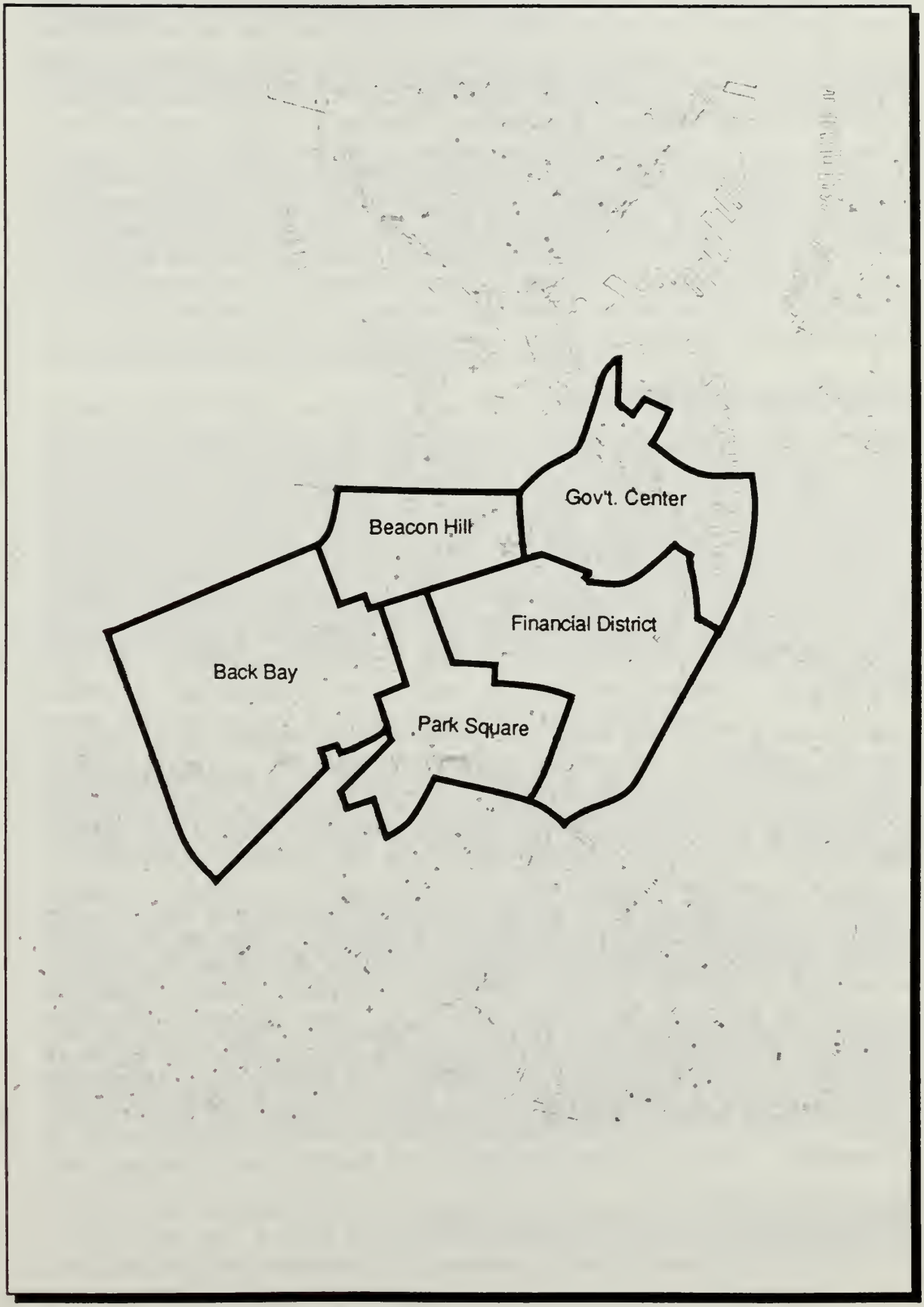


Figure 2-2
Boston Subdivisions



A gain of an additional 12,000 jobs, or seven percent, to 181,900 is expected by 1990.[3] The increase in employment is due to a significant amount of ongoing new development and redevelopment of existing facilities in the WESTBus area. In total, approximately 3.7 million additional square feet of office and retail space, as well as 2,005 new housing units, are planned for completion between 1987 and 1995.

As these figures indicate, the development emphasis within the corridor is on office space. This, combined with a trend towards smaller household sizes, contributes to the continuing trend of increasing employment and decreasing population. This should result in decreases in the number of work trips beginning in the corridor (due to a decrease in population), but an increase in the number of work trips ending in the corridor (due to an increase in employment).

Socio-Economic Characteristics

With the WESTBus area encompassing parts of Boston as well as surburban areas along Route 128, there is a considerable range in the socio-economic characteristics of the area's population. In general, population densities decline with distance away from Boston (from 20,000 persons per square mile in Allston-Brighton to 2,000 per square mile in Needham), while the relative affluence of the area's residents increases. The exception is Newton, which in many sections has less dense residential development, and significantly higher household incomes, than Dedham, Needham, Waltham or West Roxbury.

Approximately half of the study area residents are employed. As of 1980, the average household income[4] for the area was $20,972. Average incomes ranged from a high of over $34,000 in West Newton to a low of $13,555 in Allston-Brighton. Allston-Brighton incomes are significantly lower than in the rest of the area, with average incomes in all other areas above $18,000.

Patterns of average income and auto ownership are closely related. The highest concentrations of residents without a car are in South Allston/Brighton, at 35 percent, and the lowest are in Needham and Newton, at five percent and eight percent, respectively. However, overall, a significant number of residents of Allston/Brighton, West Roxbury, Waltham, Watertown and Belmont are transit dependent due to lack of access to an automobile. In these areas, from 15 percent to 35 percent of all households were without access to an automobile in 1980. For the WESTBus area as a whole, 15 percent of the area's dwelling units are without daily access to an automobile. Based on an average of 2.5 persons per dwelling unit,

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[3]MAPC employment projections, March 1987.
[4]In 1980 dollars.

approximately 40,100 of the area's residents did not have access to a car and thus relied on other means of transportation.[5]

Fifteen percent of the area's residents are age 65 or older. West Roxbury has the highest concentration of residents aged 65 or older (23 percent), and North Waltham the lowest (12 percent). Although the elderly are traditionally a highly transit-dependent group, survey results show that only five percent of the users of WESTBus routes are aged 65 or older, indicating that most of the elderly in this corridor have access to other forms of transportation. Overall, fewer than two percent of the area's elderly population use WESTBus transit services.

EXISTING TRANSPORTATION USE/PATTERNS

In 1980, 123,700 daily work trips were made by residents of the WESTBus area. The most popular work trip destination for the area's residents was the same community or neighborhood in which they lived (18 percent), followed by downtown Boston, Waltham and Newton (see Table 2-1 and Figure 2-3). However, on a more detailed level, using the WESTBus sub-areas as destinations, the most popular work trip destination becomes downtown Boston, followed by South Waltham, East Newton and Central Waltham. Of the downtown Boston destinations, 28 percent of all trips were to the Financial District, 26 percent to Government Center, 15 percent to the Back Bay and 12 percent to Beacon Hill, and nine percent to Park Square. In addition, over 40 percent of all trips were made to destinations outside of the study area, other than to downtown Boston or Cambridge.

The large majority of all work trips made from within the corridor are made by automobile, with 75 percent of all workers either driving alone or being dropped off at work. Transit (including the WESTBus routes, commuter rail and the Green Line) carries 14 percent, and the remaining 11 percent split between walking, bicycling, and other modes. Most of the transit trips are to Boston. For WESTBus areas directly served by a transit route, the transit mode split for local trips ranges from only three to eight percent, but up to 69 percent for trips to the Financial District and Government Center areas.

The WESTBus routes are designed to provide a basic level of transit service to the area, and express service to Boston. Local routes also provide feeder service to the Green Line, express bus and commuter rail service. However, due to long bus headways on local routes, and in some cases, a lack of

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[5]This figure includes only households where none of the residents have access to a car. It does not include households where at least one car is available, but not available to all members of the household.

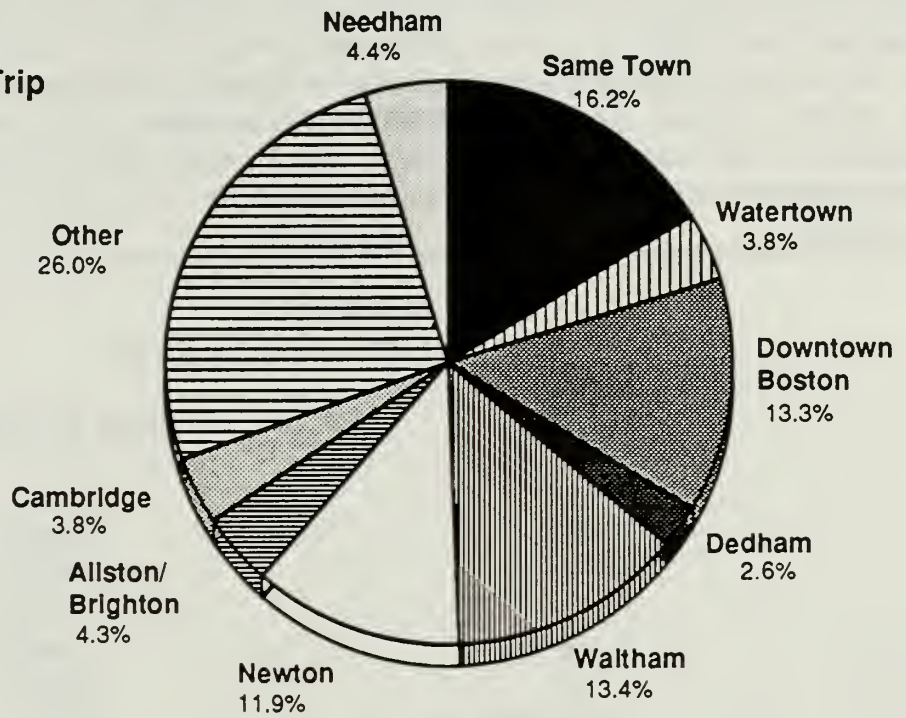
Table 2-1
Major Work Trip Locations of WESTBus Area Residents

TOWN/AREA OF RESIDENCE	Employed Residents	TOWN/AREA OF EMPLOYMENT: Home Town/ Home Area		Downtown Boston		Waltham		Newton		Allston-Brighton		Cambridge		Other	
BOSTON															
S.All-Bright	19,848	1,443	7.3%	4,640	23.4%	581	2.9%	922	4.6%	2,730	13.8%	1,033	5.2%	9,942	50.1%
W.Roxbury	11,368	1,142	10.0%	2,475	21.8%	176	1.5%	637	5.6%	426	3.7%	266	2.3%	6,246	54.9%
BELMONT	3,236	206	6.4%	227	7.0%	344	10.6%	162	5.0%	112	3.5%	386	11.9%	1,800	55.6%
WALTHAM															
N.Waltham	1,921	265	13.8%	48	2.5%	1,120	58.3%	52	2.7%	28	1.5%	28	1.5%	646	33.6%
C.Waltham	10,159	2,207	21.7%	349	3.4%	4,555	44.8%	524	5.2%	170	1.7%	434	4.3%	4,128	40.6%
S.Waltham	12,631	4,248	33.6%	344	2.7%	6,742	53.4%	848	6.7%	170	1.3%	319	2.5%	4,207	33.3%
WATERTOWN															
W.Watertown	7,541	1,053	14.0%	731	9.7%	1,018	13.5%	617	8.2%	230	3.0%	602	8.0%	3,290	43.6%
S. Watertown	3,092	345	11.2%	325	10.5%	394	12.7%	248	8.0%	134	4.3%	104	3.4%	1,542	49.9%
NEWTON															
N.Newton	14,533	1,999	13.8%	1,432	9.9%	1,608	11.1%	4,163	28.6%	453	3.1%	562	3.9%	6,315	43.5%
E.Newton	12,838	1,449	11.3%	2,629	20.5%	346	2.7%	2,816	21.9%	537	4.2%	452	3.5%	6,057	47.2%
S.Newton	6,962	642	9.2%	1,104	15.9%	298	4.3%	1,498	21.5%	204	2.9%	202	2.9%	3,656	52.5%
W.Newton	8,840	640	7.2%	1,435	16.2%	383	4.3%	2,236	25.3%	212	2.4%	331	3.7%	4,243	48.0%
DEDHAM	9,967	2,491	25.0%	1,063	10.7%	204	2.0%	350	3.5%	177	1.8%	168	1.7%	5,514	55.3%
NEEDHAM	13,812	4,016	29.1%	1,387	10.0%	482	3.5%	1,209	8.8%	255	1.8%	320	2.3%	6,142	44.5%
TOTAL/AVG	136,748	22,146	16.2%	18,188	13.3%	18,250	13.3%	16,282	11.9%	5,838	4.3%	5,207	3.8%	63,730	46.6%

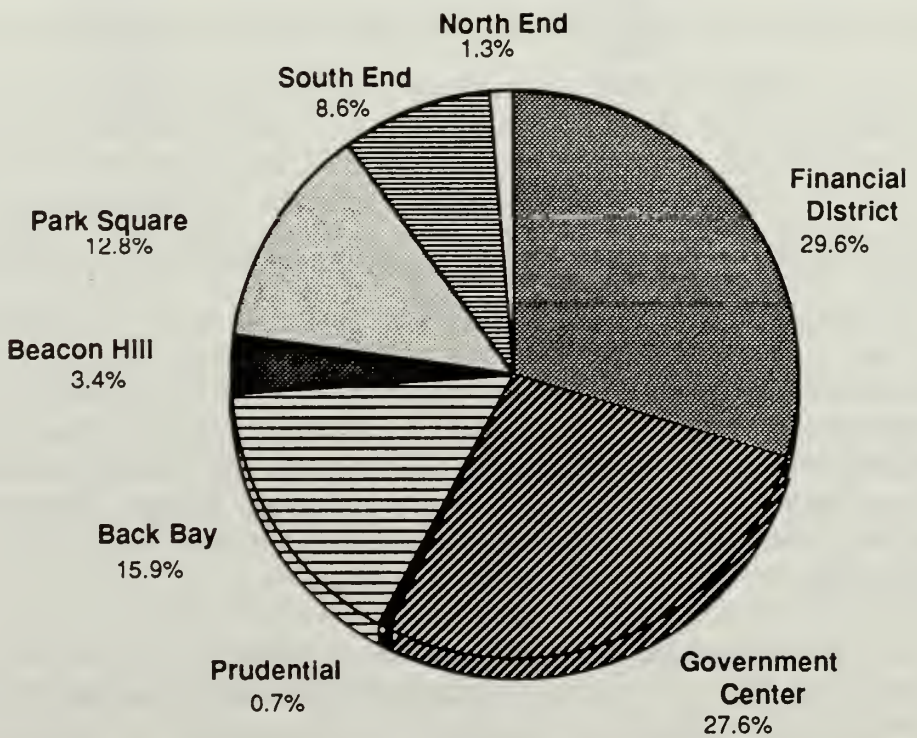
Note: Home Town/Home Area figures are independent of actual town totals; i.e. Waltham totals include trips within Waltham that are also included in the Home Town/Home Area catagory.

Figure 2-3
Major Work Trip Destinations of WESTBus Area Residents

1) Major Work Trip Destinations:



2) Distribution of Work Trips to Downtown Boston:



coordination, these are often not desirable transfers. As a result, most Green Line and commuter rail riders either walk or drive to rail stations. Total ridership on WESTBus routes, as of the Spring of 1986, was approximately 15,390 one-way trips per day, as shown in Table 2-2. Pointchecks performed on express routes through mid-1987 indicate that ridership levels have remained fairly stable since that time. Most ridership (68 percent) is on the five express routes, while only 32 percent is on the six local routes.

Table 2-2
Average Daily Ridership by Route

	Daily Ridership
Local Routes	
52	1,340
53	830
54	650
56	580
58	390
59	1,170
Subtotal	4,960
Express Routes	
300	1,610
301	2,220
302	1,330
304	3,830
305	1,440
Subtotal	10,430
WESTBus Total:	**15,390**

With the exception of Route 57, which was included in the Central North Bus Study, the local routes listed above provide the only local service in the WESTBus area. Service to Boston, however, is also provided by the Green Line and commuter rail. Route 300 from Riverside and Route 301 from Brighton operate south of the Mass Pike, as does the Green Line. The other three express routes operate north of the turnpike. Commuter rail operates throughout many areas of the WESTBus corridor, both north and south of the Mass Pike.

For all trip purposes, ridership levels to Boston are about 12 percent higher on the Green Line than on express buses. Commuter rail ridership from stations in Newton and Waltham is relatively low compared to Green Line and express bus ridership, at approximately 1,500 trips per day (see Table 2-3).

Table 2-3
Express Bus, Green Line and Commuter Rail Ridership from within the WESTBus Area

	Express Bus (Spring '86)	Green Line (Spring '85)	Commuter Rail (Fall '86) .
Express Bus	10,430		
Green Line			
Riverside		3,090	
Woodland		2,100	
Waban		920	
Elliot		940	
Newton Highlands		2,030	
Newton Centre		2,580	
Commuter Rail			
Brandeis/Roberts			480
Waltham Center			390
Waverley			140
Auburndale			40
West Newton			40
Newtonville			450
Totals:	**10,430**	**11,660**	**1,540**

Express bus service overlaps with commuter rail at Waltham Center, West Newton and Newtonville. At Waltham Center, where peak period commuter rail headways are 25 to 40 minutes and Route 305 headways are 10 minutes, ridership is split fairly evenly between the two types of services. At West Newton and Newtonville, where headways on commuter rail and through-routed local services are comparable, commuter rail ridership is slightly higher.

On the WESTBus routes, transfer rates range from seven to 62 percent. The average transfer rate is 33 percent, but as shown in Table 2-4, transfer rates vary greatly between local routes and express routes. On local routes, transfer rates average 58 percent to the Green Line, express buses or other local routes. There are very few transfers to and from commuter rail. On express routes, a much lower number of trips involve transfers, an average of only 21 percent. Further, many of these "transfers" are with local trips that are through-routed with Route 304.1 and do not involve a physical change of buses or any of the wait time usually associated with transfers.

Table 2-4
WESTBus Socio-Economic and Travel Characteristics
(Weekdays)

	SOCIO-ECONOMIC CHARACTERISTICS				TRAVEL CHARACTERISTICS, % Transfers			
	Age		% w/o	% < $15K	To/Fr Rapid	To/Fr Local	To/Fr Express	% Ride ≥5 Days
	<18	>64	Auto	Inc	Transit	Buses	Buses	/Week.
Local Routes								
52	26.5%	5.3%	83.4%	29.5%	19.7%	24.0%	9.9%	71.5%
53	23.1%	10.1%	85.5%	33.7%	1.2%	27.3%	20.8%	73.3%
54	4.8%	17.8%	78.8%	43.0%	0.0%	28.9%	33.0%	70.4%
56	17.8%	14.4%	74.5%	25.9%	0.5%	15.6%	30.7%	79.1%
58	3.7%	7.6%	72.3%	37.4%	1.0%	10.0%	31.1%	80.3%
59	14.3%	10.8%	86.0%	40.1%	27.8%	19.6%	3.2%	64.6%
Avg:	**17.3%**	**10.3%**	**81.8%**	**34.7%**	**12.2%**	**22.1%**	**24.1%**	**71.6%**
Express Routes								
300	3.1%	1.5%	16.3%	3.2%	12.0%	1.4%	0.0%	81.9%
301	1.6%	3.4%	44.2%	4.7%	4.8%	2.0%	0.0%	88.9%
302	1.0%	2.0%	51.9%	12.1%	7.7%	25.1%	0.0%	81.6%
304	0.6%	3.7%	28.3%	5.3%	5.6%	23.1%	0.0%	81.8%
305	0.3%	4.1%	36.6%	10.0%	12.2%	3.8%	0.7%	86.9%
Avg:	**1.2%**	**3.1%**	**34.0%**	**6.4%**	**7.6**	**12.9%**	**0.1%**	**84.0%**
WESTBus Avg	**0.2%**	**5.3%**	**48.3%**	**13.8%**	**9.6%**	**14.9%**	**8.0%**	**80.2%**

Nearly all of the transfer trips involve only one transfer. This is true on both local and express routes. For all trips combined, fewer than one percent involved two or more transfers, and on no one route did more than four percent involve two or more transfers. The highest number of transfers occur between Routes 53 and 304, at 280 per weekday, and between Routes 54 and 304, at 305 per day. The relatively high number of transfers between these routes is due to the through-routing of most trips on these two route combinations, and which do not require a physical transfer.

A number of statistics that typically indicate transit dependency are also shown in Table 2-5. As can be seen from these figures, there is a high level of transit dependency among local route riders, but a low level of transit dependency among express riders: on local routes, 28 percent of all riders are

younger than 18 or older than 64, 82 percent are without access to an automobile, and 35 percent have a household income of less than $15,000 per year. On express routes, however, only four percent are younger than 18 or older than 64, 34 percent do not have an automobile available, and only six percent have a household income of less than $15,000.

LATENT DEMAND

Local Service

A number of factors are responsible for the differences between local and express riders and the ridership levels on the two types of services. Primary among these are headways, trips times, and a need to transfer to complete many local trips. As currently operated, local service can be characterized as providing infrequent service with relatively long trip times, especially in comparison to auto travel times, and a need to transfer on most trips. Express service, on the other hand, provides travel times comparable to automobile travel times, short peak period headways and a one seat ride in most cases.

However, while the causes are obvious, solutions are more difficult. Current long headways for local services reflect low demand for these services rather vice versa. Other than Waltham Center, Watertown Square and, to a lesser extent, Newton Corner, there are few concentrated locations in the WESTBus area that attract a large number of local trips. Instead, most trip attractors are widely scattered and thus the total amount of travel between specific interchanges is relatively low, especially when compared to the total number of trips to downtown Boston. As shown in Table 2-6, most of these interchanges are already served. The major exception within the WESTBus area are trips between "South" Waltham and "Central" Waltham, which has the single largest volume of any pair of interchanges in the area, with over 3,000 one-way work trips per day.

At present, Routes 53, 54, 56, and 58 provide service between Central and South Waltham, but only to a limited extent. Most of these trips, if made by transit, would require a transfer at Waltham Center and long transfer times since service at Waltham Center is currently scheduled to best serve existing demand to Newton Corner and to Boston rather than potential demand between Central and South Waltham. Changes to routes through Waltham Center and/or the coordination of exisitng service could eliminate transfers or reduce transfer time at Waltham Center to attract additional ridership from this market without worsening service for existing passengers. Possible changes in this respect are discussed in Chapters 3 and 5.

Table 2-5
Transit Connections Between Major Work Trip Interchanges

Rank	Interchange	# One Way Work Trips	Transit Connections	Comments
1	Central Waltham to South Waltham	1,560	Routes 53, 54, 56, 58 and Route 305.	Direct connections from most of Central Waltham but very low transit mode share (4%). Most trips require transfer.
2	South Waltham to Central Waltham	1,478	Same as above.	Same as above.
3	South Allston/Brighton to Financial District	1,139	Green Line and Route 301 direct, or Route 57 to Green Line.	High transit mode split (78%), but no direct service from north of Brighton Center.
4	South Allston/Brighton to Government Center	1,046	Route 301 direct or Route 57 to Green Line.	High transit mode split (74%), but no direct service from north of Brighton Center
5	North Newton to East Newton	1,015	Route 52 and Route 59.	Direct connections from most of North Newton but very low transit mode share (5%), long headways.
6	South Waltham to North Waltham	865	Route 56 and Route 58.	Direct connections but very low transit mode share (2%), long headways.
7	East Newton to North Newton	738	Route 52 and Route 59.	Direct connections from areas along Routes 52 and 59, but no transit useage for work trips.
8	West Newton to East Newton	678	Green Line or Route 59.	Direct connection but only to/from specific areas, low transit mode share (10%).

Table 2-6 (Continued)
Transit Connections Between Major Work Trip Interchanges

Rank	Interchange	# One Way Work Trips	Transit Connections	Comments
9	East Newton to Back Bay	671	Route 59 to Routes 57 or 302.	No direct connections to Back Bay.
10	Central Waltham to North Waltham	659	Route 54 to Route 56, or Route 56 direct.	Direct connections but very low transit mode share (2%).
11	East Newton to Government Center	643	Routes 52 or 59 to Routes 301, 302 or 304 or Green Line.	High transit mode split (61%) Direct Green Line service from most of East Newton.
12	South Allston/Brighton to Back Bay	618	Routes 57 or 301 or Green Line.	No direct connections to Back Bay.
13	East Newton to Financial District	603	Routes 52 or 59 to Routes 301, 302, 304 or Green Line.	High transit mode split (61%) Direct service from most of East Newton.
14	Needham to South Newton	576	Route 59.	Limited direct connections, very low transit mode share (4%).
15	South Allston/Brighton to Cambridge	566	Green Line direct to East Cambridge, and Red Line or Route 301 to Red Line, or Rts 63 and 64 direct.	Moderate transit mode split (43%) Connection is difficult, headways long and transfered.
16	North Newton to South Waltham	557	Routes 53, 54, 56, 58 and 305.	Direct connections but very low transit mode share (5%).

Table 2-6 (Continued)
Transit Connections Between Major Work Trip Interchanges

Rank	Interchange	# One Way Work Trips	Transit Connections	Comments
17	West Roxbury to Government Center	554	Route 52 to Green Line or Routes 301, 304; Routes 35, 36, 37 to Green or Orange Lines.	High transit mode split (64%). One transfer required from most of West Roxbury. Better connections thru Forest Hills than thru WESTBus area.
18	West Roxbury to Financial District	549	Same as above.	Moderate transit mode split (43%). One transfer required from most of West Roxbury. Better connections thru Forest Hills than thru WESTBus area.
19	North Waltham to Central Waltham	501	Routes 56 and 58.	Direct connections but no transit usage.
20	South Allston/Brighton to Park Square	487	Green Line or 301 to Red Line, or Route 57 to Green Line.	Moderate transit mode split (43%). Connection is difficult, up to two transfers required.
21	South Allston/Brighton to Beacon Hill	479	Green Line or 301 to Red Line, or Route 57 to Green Line.	Moderate transit mode split (43%). Connection is difficult, up to two transfers required.
22	West Watertown to South Waltham	478	Route 58.	Direct connection but very low transit mode share (15%), long headways.
23	South Newton to East Newton	458	Route 52 and Route 59.	Direct connections but no transit usage for work trips.
24	West Newton to North Newton	451	Route 59.	Direct connections but very low transit mode share (2%).

Table 2-6 (Continued)
Transit Connections Between Major Work Trip Interchanges

Rank	Interchange	# One Way Work Trips	Transit Connections	Comments
25	Needham to Financial District	436	Route 59 to Green Line, or commuter rail.	High transit mode split (61%) One transfer then direct service from most of Needham.
26	Needham to Government Center	421	Route 59 to Green Line or commuter rail to rapid transit.	Moderate transit mode split (48%).
27	North Newton to North Waltham	419	Route 56 direct or connect to Route 56 from Routes 52, 53, 54, 58, 59.	Direct connections but no transit usage for work trips.

In terms of service coverage, most of the WESTBus area is already within a quarter of a mile of either bus, Green Line or commuter rail service (see Figure 2-4). Exceptions are parts of Newton between Routes 59 and 300 and east of Route 52, the western halves of Needham and Dedham, sections of West Roxbury, and between Watertown Square and Waverley Square. With the exception of the latter, all of these areas have low population and development densities, and would be difficult to serve effectively with transit service.

Between Watertown Square and Waverley Square, the area is mostly residential in nature and similar to many areas of Waltham that are served, and could conceivably support transit service. There would be two major options for providing this type of service, as discussed in Chapters 3 and 10: (1) an extension of local service between Watertown Square and Waverley Square, or (2) an extension of express service from Watertown Square.

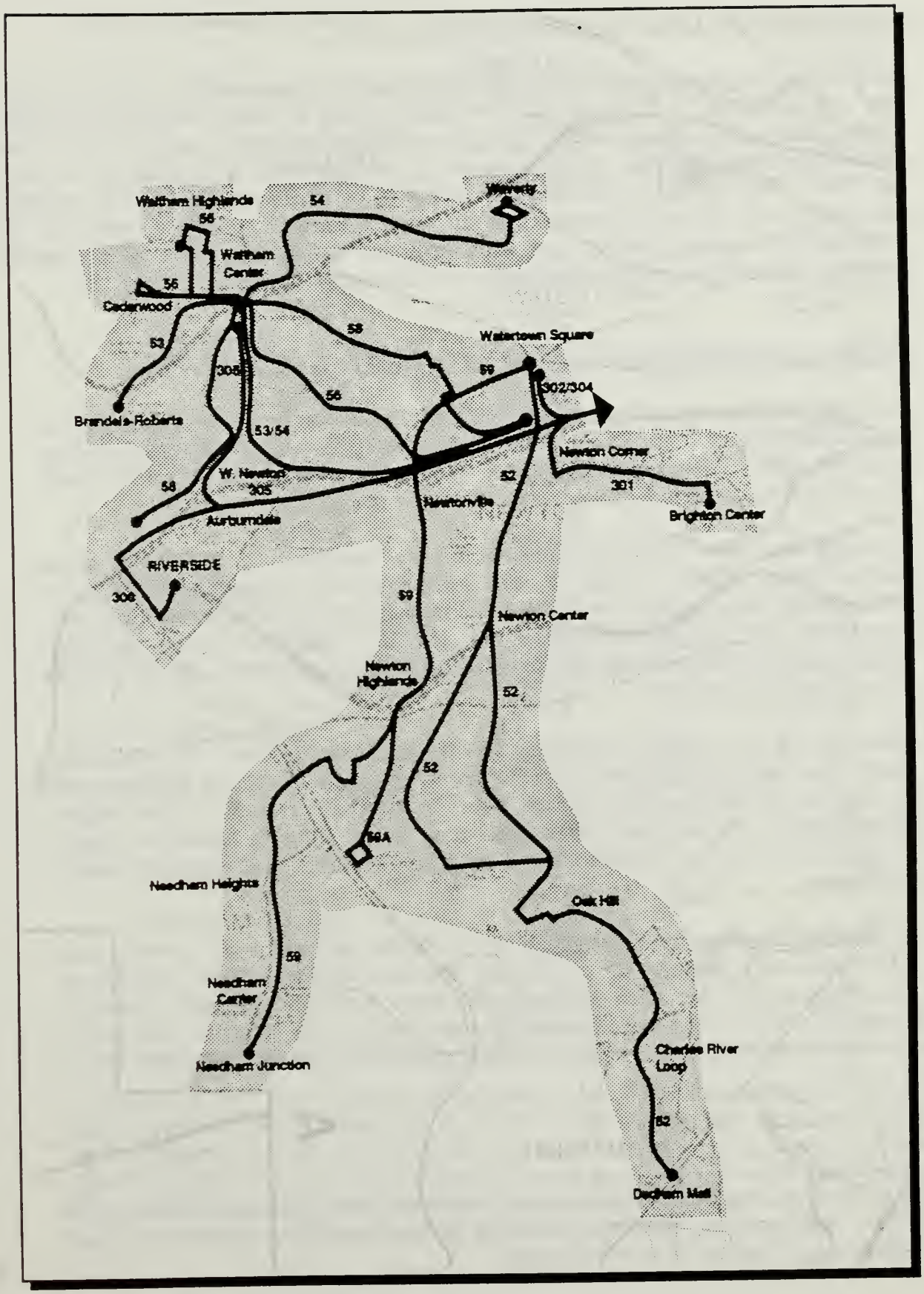
To reduce the number of transfers between local routes, local routes could be through-routed or pairs of local routes could be combined. However, most of the transfers between local routes involve many different routes, most of which provide connections to locations beyond the WESTBus area. As a result, the combination of local route pairs would not significantly reduce the number of transfers required, and in many cases, would result in very long routes.

However, as previously mentioned, there are a large number of transfers between local routes and Route 304. In addition, there are also a large number of transfers with Route 302 to Copley Square. In most cases, the through-routing of additional local service with Route 302 or 304 would attract new riders (to both local and express services), as well as eliminate transfers for existing riders. The through-routing of an increased number of local trips is discussed in all of the chapters on local routes (Chapters 3 through 7), as well as in Chapters 10, 11 and 12.

Express Routes

All express routes except Route 302 operate to an inner terminal at Federal and Franklin Streets in the Financial District, and within walking distance of Government Center. Route 302 provides service to Copley Square. As previously mentioned, most work trips from the WESTBus area (all modes) are made to these areas. There are also a large number of trips made to the Beacon Hill and Park Square areas. These areas lie between the terminals of existing express service at Copley Square and Federal and Franklin Streets, and are beyond one-quarter mile walking distance of either. As a result, an extension of Route 302 to Beacon Hill or Park Square, or the re-routing of other express routes through these areas could attract new riders to express bus service. These options are discussed in Chapters 8 through 11.

Figure 2-4
Area within One-Quarter Mile of WESTBus Routes



Overlap between Local and Express Routes

At present, most peak period, peak direction express trips are full, while local trips are underutilized. With additional through-routing of local routes with express routes, additional Boston bound riders could be attracted to local services. This would increase ridership on local routes, as well as reduce demand on express services. This, in effect, would allow riders to be shifted from crowded express trips to local trips with excess capacity, which could then allow service to be reduced on express routes, and thus improve the productivity of the entire system. These types of improvements are discussed in Chapters 11 and 12.

IMPACT OF NEW DEVELOPMENT WITHIN THE WESTBus AREA

New development planned for the WESTBus area will generate an estimated 3.7 million square feet of new office and retail space and 2,005 new housing units by 1995. The new development will generate approximately 8,700 new jobs,[6] an increase of five percent over 1987 levels.

Most of the new development will be in Newton and Waltham, with respectively, 1,298,000 square feet and 1,149,000 square feet of new office/retail/hotel space (see Table 2-6). In the sections of Belmont, Dedham, Needham and Watertown that are in the WESTBus area, planned commercial development ranges from 81,000 square feet (Belmont) to 563,000 square feet (Needham).

Most of the new office development will occur in Newton. In Waltham, nearly half of the commercial development, in terms of square footage, will be two large hotels along Route 128. In Dedham, much of the largest development will also be a large hotel near Route 128. In Needham, major changes involve the redevelopment of a large number of relatively small properties.

In terms of housing, Newton again has the most planned development, with 1,111 new units planned for completion between 1987 and 1995. Watertown and Waltham follow with 367 and 350 units, respectively. As shown in Figure 2-5, most of the large planned developments (over 50,000 square feet or 40 or more housing units) will be in areas already served by the MBTA.

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[6]Based on an approximate relationship between new jobs and the size of an office development that approximately 100 jobs will be created for every 43,000 square feet of new development.

Table 2-6
Summary of Planned Development in WESTBus Area

Development Type	Total Square Feet	Housing Type	Total Units
Newton			
Retail	94,000	Condo	1,111
Office	1,204,000		
Total	**1,298,000**		**1,111**
Waltham			
Hotel	625,000	Condo	350
Office	524,000		
Total	**1,149,000**		**350**
Needham			
Misc.	93,000	Rental	105
Retail	54,000	Condo	12
Office	416,000		
Total	**563,000**		**117**
Dedham			
Distribution	15,000	Single	
Misc.	256,000	Family	44
Office	135,000		
Total	**406,000**		**44**
Watertown			
Office	167,000	Condo	186
		Townhouse	61
		Rental	89
Total	**167,000**		**367**
Belmont			
Misc.	76,000	Rental	16
Office	5,000		
Total	**81,000**		
Total	**3,664,000**		**2,005**

In only one case does a major development not lie within a quarter-mile of existing routes. This development of 143 condominium and apartment units (#20 in Figure 2-5) lies three-quarters of a mile from Route 54. High estimates would suggest that this development would generate up to 33 new transit trips, which would be a five percent increase in Route 54 ridership if that route were to be re-aligned to serve the new development.

Figure 2-5, Part 1
Proposed Development

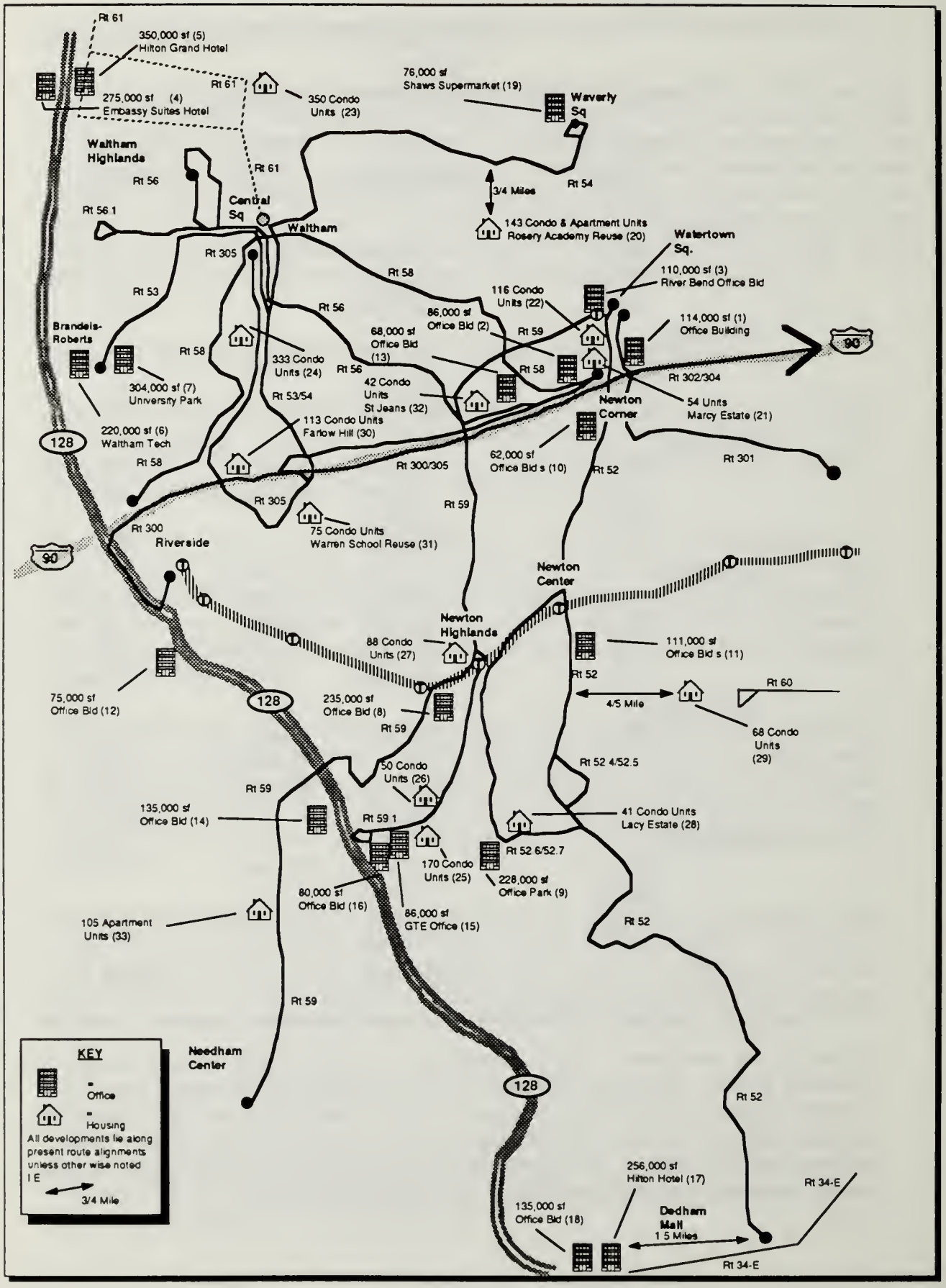


Figure 2-5, Part 2
Key to Proposed Development

ID	Town	Location	Type	#Units/Size	
1	Newton	Two Newton Place	Office	114,000	Sq Ft
2	Newton	3 Nonantum Office Park	Office	86,000	Sq Ft
3	Watertown	River Bend	Office	110,000	Sq Ft
4	Waltham	Embassy Suites	Office	275,000	Sq Ft
5	Waltham	Hilton Grand Hotel	Office	350,000	Sq Ft
6	Waltham	Saracen/ Waltham Tech	Office	220,000	Sq Ft
7	Waltham	University Park	Office	304,000	Sq Ft
8	Newton	300 Boylston Street	Office	235,000	Sq Ft
9	Newton	85 Wells Avenue	Office	228,000	Sq Ft
10	Newton	1320 Centre Street	Office	57,000	Sq Ft
10	Newton	1148 Centre Street	Office	5,000	Sq Ft
11	Newton	Paragon Towers	Office	63,000	Sq Ft
11	Newton	40 Glen Ave	Office	22,000	Sq Ft
11	Newton	Paul Street	Office	20,000	Sq Ft
11	Newton	Newton Centre RR Sta	Office	3,000	Sq Ft
11	Newton	50 Union Street	Office	3,000	Sq Ft
12	Newton	313 Washington Street	Office	75,000	Sq Ft
13	Newton	29 Crafts Street	Office	68,000	Sq Ft
14	Needham	160 Gould Street	Office	135,000	Sq Ft
15	Needham	GTE - 254 Second Ave	Office	86,000	Sq Ft
16	Needham	300 First Ave	Office	80,000	Sq Ft
17	Dedham	Hilton	Office	256,000	Sq Ft
18	Dedham	Office Building	Office	135,000	Sq Ft
19	Belmont	Shaws Supermarket	Retail	76,000	Sq Ft
20	Watertown	Rosery Academy A	Rental	61	Units
20	Watertown	Rosery Academy B	Rental	51	Units
20	Watertown	Rosery Academy C	Other	31	Units
21	Newton	Marcy Estate	Condo	54	Units
22	Watertown	Waterbridge	Condo	71	Units
22	Watertown	Old Charles River	Condo	45	Units
23	Waltham	Lake And Lex Street	Condo	350	Units
24	Newton	Pine Street	Condo	333	Units
25	Newton	181 Oak Street	Condo	170	Units
26	Newton	Auburndale Meadows	Condo	50	Units
27	Newton	264 Centre Street	Condo	48	Units
27	Newton	Hyde School Reuse	Condo	40	Units
28	Newton	Lacy Estate	Condo	41	Units

Figure 2-5, Part 2 (Continued)
Key to Proposed Development

ID	Town	Location	Type	#Units/Size
29	Newton	97 Florence St	Condo	68 Units
30	Newton	Farlow Hill	Condo	113 Units
31	Newton	Warren School Reuse	Condo	75 Units
32	Newton	St. Jeans	Condo	42 Units
33	Needham	591 Hillside Ave	Rental	105 units

By route, Routes 59 and 53 are closest to the highest proportions of planned office developments, with, respectively, 21 and 20 percent of total new office space located along these routes. Housing developments are similarly situated, with Routes 59 and 53, as well as Route 305, closest to the most new units. Based on the trip-making characteristics of other WESTBus area residents and employees, these new developments could increase ridership on individual WESTBus routes by up to 29 percent (see Table 2-7). Total WESTBus ridership should increase by approximately 880 trips per day, or 13 percent.

Table 2-7
Ridership Impacts of Planned Development

	Commercial Space (SF)	New Trips	Housing Units	New Trips	Percent Total	Increase
Rt 52	339,000	110	41	10	**120**	**9.0%**
Rt 53	524,000	175	333	65	**240**	**28.6%**
Rt 54	76,000	25	333	65	**90**	**13.7%**
Rt 56	68,000	25	42	10	**35**	**5.3%**
Rt 58	68,000	25	333	65	**90**	**22.1%**
Rt 59	536,000	180	455	90	**270**	**22.7%**
Rt 300	75,000	25	113	20	**45**	**2.9%**
Rt 301	262,000	85	0	0	**85**	**3.9%**
Rt 302	372,000	125	170	35	**160**	**11.7%**
Rt 304	372,000	125	170	35	**160**	**4.1%**
Rt 305	0	0	521	100	**100**	**7.0%**
Total:	**2,692,000**	**900**	**2,511**	**495**	**1,395**	**13.0%**

SUMMARY/OUTLOOK

The WESTBus corridor is largely a stable area with well established travel patterns, but one that is also experiencing a significant amount of new development. Existing trips are made to a large number of widely scattered locations within the WESTBus area, and to downtown Boston. Inside of Route 128, transit service is provided within one-quarter mile of the area's residents with the exception of some areas of Newton and in Watertown between Watertown Square and Waverley Square. Outside of Route 128 in Needham, Route 59 and commuter rail serves most densely developed areas of the town. As a result of this network, a basic level of service is provided to most of the area's residents. However, due to the low level of service provided on local routes, these routes carry mostly transit dependent riders, with relatively few persons riding by choice. Express routes, on the other hand, provide a very high level of service during peak periods, and attract mostly those that ride by choice and leave their cars at home.

At the present time, ridership on WESTBus routes is stable. Based on current development and employment trends and the absence of other outside influences, these routes should experience moderate increases of one to two percent over the next few years. In addition, other changes should also be possible to attract additional riders, as well as improve the system for existing riders. These types of improvements, which are listed below, are also discussed in more detail in the following chapters.

- WESTBus routes have high transfer rates. The number of physical transfers between local and express routes could be reduced by increasing the number of local and express trip that are through-routed. Between local routes, the total number of transfers cannot be significantly reduced, but some improvements should be possible through improved coordination of services in Waltham Center. (See Chapters 3 through 7, and Chapters 11 and 12.)

- Direct connections do not currently exist to the Park Square or Beacon Hill areas of Boston although a large number of trips are made to these areas from the WESTBus corridor. The operation of express service to these areas would attract more of these trips to transit. (See Chapters 8 through 10.)

- After downtown Boston, Waltham is the largest trip attractor for residents of the WESTBus area, but the transit share of work trips is only three percent. Improved schedule coordination between routes operating in Waltham or the re-routing of certain routes could increase the transit share of these trips. (See Chapter 4.)

- Currently, no service is provided within one-quarter of a mile of those who live between Watertown Square and Waverley Square. This area is fairly densely populated, and depending upon the type of service provided, could be a source of new local or express ridership, or both. (See Chapters 4 and 10.)

3. Route 52

Route 52.0 Charles River - Watertown Square via Parker & Dedham Streets
Route 52.1 Dedham Mall - Watertown Square via Parker & Dedham Streets
Route 52.3 Charles River - Newton Corner via Parker & Dedham Streets
Route 52.4 Charles River - Watertown Square via Meadowbrook
Route 52.5 Dedham Mall - Watertown Square via Meadowbrook
Route 52.6 Charles River - Watertown Square via Community Center
Route 52.7 Dedham Mall - Watertown Square via Community Center

ROUTE PROFILE

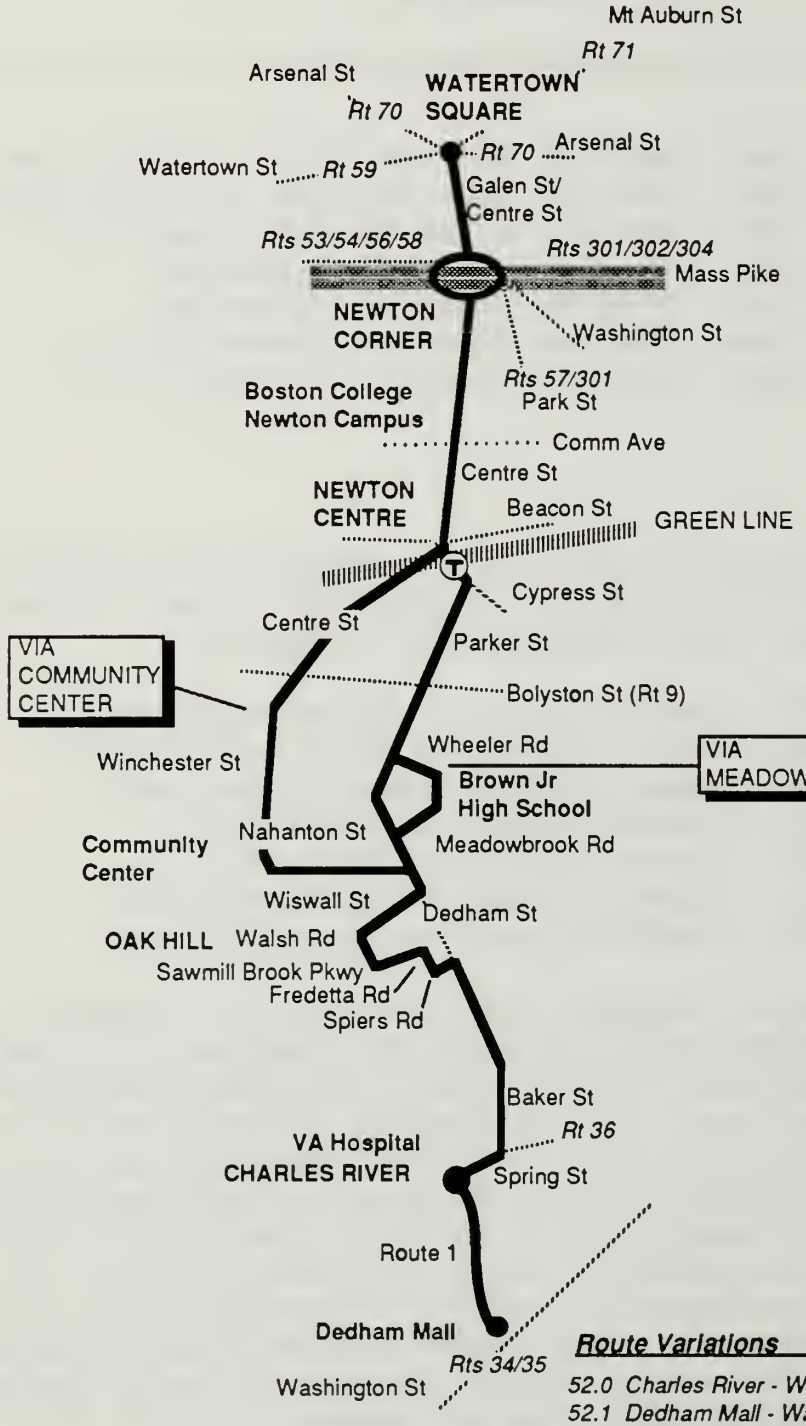
There are seven variations of Route 52. Six operate between Watertown Square and either the Dedham Mall or Charles River; the seventh operates between Newton Corner and Charles River (see also Figure 3-1):

52.0 Charles River - Watertown Square via Parker/Dedham Streets
52.1 Dedham Mall - Watertown Square via Parker/Dedham Streets
52.3 Charles River - Newton Corner via Parker/Dedham Streets
52.4 Charles River - Watertown Square via Meadowbrook
52.5 Dedham Mall - Watertown Square via Meadowbrook
52.6 Charles River - Watertown Square via Community Center
52.7 Dedham Mall - Watertown Square via Community Center

Most of the variations are designed to serve specific markets during specific periods. At the outer end, service before 9:00 AM terminates at the Charles River Loop. After that time, when the Dedham Mall is open, service operates through Charles River Loop to and from the mall. Between Newton Center and Oak Hill, after 9:30 AM, the 52.1 and 52.7 variations run alternate trips. The 52.1 variation provides the most direct service via Parker and Dedham Streets, while the 52.7 variation operates via Centre Street, Winchester Street and Nahanton Street to provide service to the Leventhal Sidmon Jewish Community Center (see Figure 3-1). Variations 52.4 and 52.5 operate only in the morning and afternoon to provide service to Brown Junior High School. Additional major activity centers served by the route are the VA Hospital, Newton Centre, Boston College's Newton Campus, the Mount Alvernia School, Newton Corner, and Watertown Square.

Figure 3-1

Route 52 *DEDHAM MALL/CHARLES RIVER LOOP - WATERTOWN SQ via NEWTON CORNER*



Route Variations

52.0 Charles River - Watertown Square via Parker/Dedham
52.1 Dedham Mall - Watertown Square via Parker/Dedham
52.3 Charles River - Newton Corner via Parker/Dedham
52.4 Charles River - Watertown Square via Meadowbrook
52.5 Dedham Mall - Watertown Square via Meadowbrook
52.6 Charles River - Watertown Square via Community Center
52.7 Dedham Mall - Watertown Square via Community Center

As shown in Table 3-1, ridership on Route 52 is low, and most riders use Route 52 because they do not have a car available. Performance in terms of boardings per vehicle mile and per vehicle hour is also low. The route, with all variations taken as a whole, barely meets normal MBTA performance standards, but does qualify for lower standards because more than 75 percent of all passengers do not have an auto available. All variations are within the lower standards during all periods.

Although most riders do not have a car available, household income levels of Route 52 riders are fairly high, with nearly half over $30,000 and 24 percent over $50,000. As a result, it appears that many do not own a car by choice, are under driving age (27% of all riders are under 18), or do not drive for other reasons. In total, 500, or 43 percent of those without an auto available, also do not have a driver's license.

Most Route 52 trips are made by residents of Newton (58 percent) and involve trips to northern Newton, Watertown or Boston. Half of all Route 52 trips are work related, 15 percent are school trips, 9 percent are for shopping, 9 percent are non-home based trips and 16 percent are for other home based purposes. Ridership is heavily peaked in the inbound direction (towards Watertown Square) in the AM peak and in the outbound direction in the PM peak. Most passengers (85 percent) walk to and from the route at the outer end of their trip, but nearly half transfer to or from another bus (31 percent) or the Green Line (17 percent) at the inner end. Most bus transfers are with Route 57 (60 transfers per day), Route 59 (10), Route 70 (65), Route 71 (85) or Route 304 (120). All of the Green Line transfers occur at Newton Centre.

SERVICE COVERAGE

Overall Assessment

Although Route 52 is a long route, the market for local trips that it directly serves[7] is small. Based on the 1980 US Census, there are only about 1,050 work trips per day that could be directly served by the route. The route carries approximately 140 of these trips, resulting in a transit mode split of 13 percent, high for the WESTBus area. The local market is small because most work trips are made to a large number of widely scattered locations. The destinations of 91 percent of the work trips made by residents of Route 52's service area are beyond the immediate area. The largest groups of these are to downtown Boston, primarily to the Financial District/Government Center (4,020 work trips) and Back Bay/Park Square areas (2,780 work trips).

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[7]Trips directly served refers to trips that begin and end within one-quarter of a mile of the route.

Table 3-1
Route 52 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:15AM - 7:30PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 52.0	9.8	9	30	--	--	--	--	88.4	6.8
Rt 52.1	10.4	20	--	60	30	60	--	208.5	15.0
Rt 52.3	9.1	4	--	--	--	--	--	36.5	3.0
Rt 52.4	9.4	2	35	--	--	--	--	9.4	1.5
Rt 52.5	10.5	1	--	--	--	--	--	10.6	1.6
Rt 52.6	10.6	3	--	--	--	--	60	31.7	2.3
Rt 52.7	11.4	18	--	60	60	30	60	204.8	13.5
Total:		**57**	**26**	**30**	**30**	**30**	**30**	**589.8**	**390.3**

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 52.0	250	3.2	1.2	--	--	36.7
Rt 52.1	420	--	1.6	2.5	2.4	28.1
Rt 52.3	140	2.1	--	9.1	--	47.0
Rt 52.4	70	7.8	--	--	--	48.7
Rt 52.5	80	--	--	15.5	--	108.0
Rt 52.6	40	2.0	--	--	--	16.4
Rt 52.7	340	--	1.6	2.0	1.8	25.3
Total:	**1,340**	**3.2**	**1.6**	**3.4**	**2.2**	**31.4**

Financial Statistics (Annual - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
52 All	$556,266	$152,451	$403,815	27.4%	$1.16

Other
Percent of passengers 65 or older: 5.3%
Percent without a car available for trip: 83.4%
Peak Load Points: Inbound: Between Route 9 and Mt. Alvernia School.
Outbound: Between Route 9 and Comm Ave.

Since the local work trip market is small and transit already achieves a relatively high mode split within this market, significant increases from within this market are not likely. However, the route's productivity could be increased by eliminating service on the Community Center variation, where ridership is extremely low, and by adjusting mid-day headways.

The best opportunity for increasing ridership on Route 52 would be through providing improved service or connections to and from downtown Boston. Alternatives to increase ridership from within this market would be (1) increased frequencies to reduce transfer times between Route 52 and service to and from downtown Boston, (2) through-routing some or all service to Boston, or (3) the implementation of express service to downtown Boston. However, as further discussed below, these measures would be either too costly, or leave a large number of existing riders unserved.

Improved Connections to Downtown Boston Through Reduced Headways on Route 52

At present, travel to and from downtown Boston via Route 52 requires a transfer with the Green Line or express buses operating through Newton Corner. In the inbound direction, short headways on express buses and the Green Line make this a relatively easy transfer. However, in the outbound direction, the transfer is from those services with short headways to Route 52 which has peak periods headways of approximately 30 minutes. At these headways on Route 52, average wait times are about 15 minutes, but with potential wait times of up to 35 minutes, which makes this an unattractive transfer for many potential riders.

With headways reduced from 30 minutes to 15 minutes in the peak periods, transfer times to Route 52, as well as wait times for all other Route 52 would be reduced by fifty percent to approximately seven and one-half minutes. In total, this would increase peak period ridership by 220 trips per day from 590 to 810,[8] which would be an increase in total ridership of 17 percent. Of these trips, approximately 65 would be new trips to and from Boston, while most (155) would be new local trips. However, the cost to double peak period service would be $190,000 per year, an increase of 38 percent. The operating cost per new passenger would be extremely high at $3.45, and the overall productivity of the route, which is already low, would be further reduced.

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[8]Ridership increases/decreases due to headway changes are based upon mid-point arc elasticities of -0.22 for original headways of less than 10 minutes, -0.46. for 10 - 50 minute headways, and -0.52 for headways of greater than 50 minutes.

Through-Routing of Route 52 with Route 304.1 to Downtown Boston

The through-routing of trips to downtown Boston via Route 304.1 would eliminate the transfer for trips made to and from downtown Boston via Route 304 (currently 100 per day). This would present a greater opportunity for increasing Boston bound ridership than shorter headways, but would leave many existing passengers unserved.

From the areas of East Newton and South Newton served by Route 52, 1,350 one-way work trips are made to and from downtown Boston per day. Currently, 51 percent of these work trips are made on transit. As would be expected, the large majority of these trips are made on the Green Line.(580 of 680), while 75 are made by those who drive to Newton Corner to access Route 304, and only 25 involve the use of Route 52 to the Green Line or Route 304.

Since transit usage to downtown Boston is already high, a large number of new transit trips would not be attracted by the through-routing of Route 52 with Route 304. In areas of Waltham where express service to Boston is provided, the transit mode split for trips to Boston averages 65 percent. However, express services that attract this level of transit usage have significantly shorter headways than would through-routed Route 52 service. Based on the differential between Route 52 headways and Route 305 headways, 33 percent fewer new riders would be expected with Route 52's lower level of service. This would translate into 140 new work trips per day. The through-routing would also attract new trips made for non-work purposes, although typically, there are few of these trips on express type service. Based on Route 305, only 11 percent of all trips would be non-work trips. In the case of a through-routed Route 52, this would result in approximately 17 additional new trips.

In addition to the new ridership that would be attracted, through-routed Route 52 service.could provide more convenient service to downtown Boston for a number of existing Green Line and Route 304 riders. Therefore, a certain number of those riders would be expected to shift to a through-routed Route 52. There are a number of factors that would be involved in whether or not persons would shift, primarily among these would be fares, travel times, headways, and reliability. The round-trip fare on Route 52 would be higher than on the Green Line, while travel times would be essentially the same from Newton Centre (25 - 35 minutes on the Green Line versus 28 - 31 minutes on a through-routed Route 52). Headways would be shorter on the Green Line, but reliability would be better on Route 52. Also, the Green Line also offers better distribution in downtown Boston. Three of these factors, fares, headways, and downtown distribution would encourage existing Green Line riders to stay on the Green Line, while reliability would cause some riders to shift to Route 52. For riders north of Newton Centre,

Route 52 would be faster, but from Newton Centre and south, relative travel times should have little impact on mode choices.

While it is difficult to quantify the total impact of these factors, assumptions can be made to provide an order of magnitude estimate. Assuming that one-third to one-half of downtown-bound riders would shift to Route 52 in spite of lower fares and shorter headways on the Green Line, 255 work trips would then shift to Route 52. Including non-work trips, other trips that would be made on Route 52 although not directly served (i.e., persons that would drive to Route 52), and trips to non-downtown Boston destinations, the total shift would be 490 trips per day.

However, the through-routing would also result in some ridership losses. In order to through-route service to Boston, the segment of Route 52 between Newton Corner and Watertown Square would have to be eliminated. This would leave unserved 230 trips now made to and from Watertown Square and the next closest stop, both of which would be beyond one-quarter mile walking distance from Newton Corner. Of the 230 trips, 150 involve transfers with Routes 70 and 71 in Watertown. With the through-routing of Route 52 to Boston, it is likely that nearly all of these trips would be lost, since the transfer required at Newton Corner to get to and from Watertown Square would create a two transfer trip. For the remaining 80 trips, approximately 20 would be lost by the imposition of the transfer.

After taking into account these ridership losses, the through-routing of Route 52 with Route 304.1 would result in a net gain on Route 52 of 475 trips per weekday. However, most of the additional riders would be those that shifted from other the Green Line. Overall, there would be a net loss in total transit ridership of 45 trips per day (145 new trips minus the loss of 170 between Newton Corner and Watertown Square). Further, considering that, in general, express bus riders are more affluent and far less transit dependent than are local riders, the elimination of the segment between Newton Corner and Watertown Square would cause more hardship to those left unserved than benefit to those newly served by the through-routing.

Lastly, the through-routing of Route 52 would also cause logistical problems. Nearly all Route 304.1 trips are now through-routed with Route 53, 54 and 56 trips. Therefore, to free up Route 304.1 trips to through-route with Route 52, existing through-routing arrangements on other routes would have to be changed.

Express Service from Newton Centre to Downtown Boston

Rather than through-routing Route 52 with Route 304.1, express service could be operated between Newton Centre and downtown Boston. This service

would follow the current alignment of Route 52 between Newton Centre and Newton Corner and then operate to downtown Boston via the Mass. Turnpike. An express route would have similar characteristics to the through-routed service described above, but would not operated along the southern end of the route between Newton Centre and the Charles River Loop or the Dedham Mall, and would operate at express headways.

The primary source of ridership for the express route would be from the area defined as "East Newton" along Centre Street. From within one-quarter of a mile of Centre Street, there are 450 daily one-way work trips to and from Boston with 250 of these made on transit, for a transit mode split of 55 percent. Most of these trips (155) are made on the Green Line, while 70 are made by those that drive to Newton Corner and ride Route 304, and 25 are made on Route 52 to Route 304. As with through-routed service, an express route would divert existing riders from the Green Line as well as attract new transit ridership. Since the relative differences between express bus and Green Line headways would be smaller than between Route 52 and the Green Line, the diversion would be higher. However, even with express bus headways (as on Route 305), Green Line headways would still be shorter. The relative attraction of the other factors discussed in the previous section would remain essentially the same: an express bus fare of $1.50 would be more expensive than the Green Line, while travel times would remain the same. Reliability problems on the Green Line would encourage a shift to the express bus

As in the previous section, it is difficult to accurately quantify the combined impact of all factors. As a result, a range of estimates is provided based on two different levels of service. Some of the assumptions used are extremes, but are useful for determining the range in which actual ridership would fall.

Low Estimate This estimate implies a level of service similar to that on Route 305 (10 minute peak-period headways; service only during and around the fringes of the peaks), and the following assumptions:

If the Green Line operated as reliably as express service, nearly all riders within one-half mile walking distance of the Green Line would continue to use the Green Line due to the Green Lines lower fare, shorter headways and better downtown distribution. For those not within walking distance of the Green Line but within walking distance of the new express bus, 50 percent would shift to the express bus and 50 percent would continue to take the Green Line. Those that continued to drive to the Green Line would continue to do so for the same reasons as those that would continue to walk to the Green Line: the lower fare, shorter headways, better downtown distribution, and in this case, the availability of off-peak service.

With a level of service similar to Route 305, a similar transit mode split could presumably be achieved as in areas served by Route 305, or about 65 percent to downtown Boston. Lastly, based on the utilization of express services, approximately one-third of all trips would be to to other locations, 11 percent would be non-work trips, and 11 percent would be from areas that would not be directly served.

Based on these assumptions, a new express route from Newton Centre would carry approximately 267 passengers per day. A breakdown of these trips is included in Table 3-2.

Table 3-2
Ridership Estimates for Express Route between Newton Centre and Downtown Boston[9]

	Low Estimate	High Estimate
•Those within walking distance of Green Line or Newton Corner that would shift to express route	0	20
•Percent of those NOT within walking distance of Green Line or Newton Corner that would shift to express route	39	94
•Percent of those that now drive to Route 304 that would shift to express route	33	65
•Shift from Route 52 for downtown trips	27	14
•New Transit Riders	43	88
•Subtotal (Total Work Trips to/from Financial Dist/Gov't Ctr from areas directly served by express routes)	142	280
•Additional trips from areas not directly served	18	35
•Non-Work Trips	20	39
•Trips to other than downtown Boston	88	174
Total Express Bus	***267***	***527***

[9]Note: estimates do not include additional ridership at Newton Corner (Route 304 riders that would board a Newton Centre express bus if it were the first to come along), or local ridership, if permitted.

High Estimate The high estimate assumes that with a service level comparable to Route 304 (four to five minute peak headways; 11 to 15 minute off-peak headways), the transit mode split for work trips could be as high as 75 percent, up from a current 55 percent. In addition, it also assumes that Green Line riders would only be willing to walk one-quarter mile (as opposed to one-half mile in the low estimate), and that 50 percent of those riders would still shift to the new express service (due to the availability of a seat on the express bus and the better reliability of express bus service). It also assumes that 90 percent of those beyond walking distance of the Green Line would shift to the new express service. Like the low estimate, it also assumes that one-third of all trips would be to locations other than downtown Boston, 11 percent would be non-work trips, and 11 percent would be from areas that would not be directly served.

Based on these assumptions, total ridership would be 527 trips per day. As shown in Table 1, most of these trips would be made by those who shifted from existing MBTA services.

Both estimates indicate lower ridership on an express route than for the through-routed service discussed in the previous section, in spite of a higher level of service. This is because an express route operating only as far as Newton Centre would not likely attract riders from south of Newton Centre (except those within walking distance). The market south of Newton Centre is larger than that north of Newton Centre, and would be served by through-routed Route 52 service, but not by the express route.

Overall, both estimates indicate that the market between Newton Centre and Newton Corner is not large enough to warrant express service. Even based on the high estimate, loads would be very low, with most trips less than half full. In addition, as with through-routed service, most of the express bus ridership would come from other existing MBTA services, and the gain in new transit ridership would be small. Lastly, the new service would also be costly. With a level of service comparable to Route 305, the annual operating cost would be nearly $507,000.

Changes to Route Variations

With respect to areas that are already served, ridership is extremely low on two sets of route variations. The first set consists of the Community Center variations (Routes 52.6 and 52.7), which operate between Newton Centre and Oak Hill via Centre Street, Winchester Street and Nahanton Street. The second set of variations are those that operate beyond the Charles River Loop to the Dedham Mall (Routes 52.1, 52.5, and 52.7).

Community Center Variations The Community Center variations were instituted in 1984 primarily to provide service to the Leventhal Sidmon Jewish Community Center (JCC). As of the Spring of 1986, the stops along the Community Center variation were utilized for only 60 trips per day (30 to and from the JCC). At this ridership level, the variations serve only 30 persons per day and less than two riders per bus trip. By comparison, 135 persons use the stops along the Parker/Dedham Street alignment between Newton Centre and Oak Hill to make 270 daily trips.

Since Community Center trips alternate with trips that operate straight through along Parker and Dedham Streets during all periods except the AM peak, headways on both variations are only 60 minutes between Newton Centre and Oak Hill. With the elimination of the Community Center variation, headways on the major variation along Parker and Dedham Streets could be shortened to 30 minutes, which should attract an additional 65 riders to that segment, accounting for an additional 130 trips per day, for a net gain of 70 trips per weekday. The elimination of the Community Center variation would also result in a small operating cost savings of about $9,600 per year.

Dedham Mall Service The service along Route 1 from the Charles River Loop to the Dedham Mall (Routes 52.1, 52.5, and 52.7) is used for only 120 trips per weekday, or an average of 3 persons per one-way bus trip. Roughly half of these trips are to and from the mall, and half are transfers with Route 34 made at the mall. However, when ridership at the Dedham Mall stop is compared to other stops along the route, the stop is the fourth most heavily utilized after Newton Centre, Newton Corner and Watertown Square. In addition, the cost to provide service to the Mall is low since the additional service is provided with the same number of vehicles that would be required without the service.

The low performance of the segment is attributable to there being only the one stop at the mall over the entire 1.5 mile length of the segment. Due to the physical layout of Route 1, which has a guard rail and fence in the median strip, additional stops along the segment would not be possible. An alternative alignment to the mall that could serve additional stops would be to continue along Baker Street straight across Spring Spring Street to Centre Street, and then along the alignment of Route 35 to the mall. However, this would leave unserved the VA Hospital/Charles River Loop stops, used for over 120 trips per weekday. Further, there are very few work trips made between West Roxbury and Newton, so that ridership would be low. As a result, service to the Dedham Mall should continue to operate along its present alignment.

LEVEL OF SERVICE

For all Route 52 variations combined, service operates at approximately 30 minute headways throughout the day. Exceptions are during the AM peak and school periods when additional trips are provided to serve student ridership, during which time headways between two specific trips can be as low as two minutes. As previously discussed, along the middle of the route between Newton Centre and Oak Hill, along Parker and Dedham Streets, and along the Community Center variation, because service alternates between Route 52.1 and Route 52.7, headways are 60 minutes.

At these service levels, crowding is not a problem except on two school trips (see Table 3-3). On these two trips, a 2:17 PM Route 52.3 departure from the Charles River Loop and a 2:15 PM Route 52.5 departure from the Dedham Mall, maximum loads approach 70 passengers. However, the crowding is of short duration (from the vicinity of Brown Junior High to Newton Centre), and only on those two trips. As a result, rather than providing an additional trip, short-term crowding should be tolerated

Table 3-3
Route 52 Peak Loads

	AM Peak		Base		School		PM Peak	
Variation	In	Out	In	Out	In	Out	In	Out
52.0	28	18	7	--	--	--	--	--
52.1	--	--	10	10	9	19	12	19
52.3	8	10	--	--	62	--	12	--
52.4	--	27	--	--	--	--	--	--
52.5	--	--	--	--	68	--	--	--
52.6	11	--	--	--	--	--	--	--
52.7	--	--	9	15	14	20	14	13
Average:	**23**	**18**	**15**	**13**	**33**	**19**	**13**	**18**

During the AM and PM peaks, although passenger volumes could be accommodated with longer headways, headways should remain at 30 minutes. During these periods, 45 minute headways could save one vehicle, but would result in very long peak period headways, and the loss of 100 trips. It would also result in an additional 61 hours of wait time per day for those who continued to use the route, or 11.2 hours of additional wait time for each of the 5.5 hours of vehicle time saved.[10]

[10]MBTA Service Planning often uses an informal standard that headways should not be lengthened if the additional wait time caused to passengers is

During the base period, when vehicle loads are lowest, 45 minute headways should be considered. During this period, the lengthening of headways to 45 minutes would save one vehicle and 5.0 vehicle hours at a cost of only 60 trips per day. The increase in passenger wait time for the remaining passengers would be 35.5 hours, or 7.1 hours additional passenger wait time for each hour of vehicle time saved. The savings in operating costs would be $59,000 per year.

RELIABILITY

When ridechecked, 95 of 96 Route 52 trips left within 3 minutes of scheduled departure time, for an on-time performance rate of 99 percent. Some lateness occurs along some segments of the route, but most of it is attributable to normal running time variability, and scheduled layover is sufficient to prevent lateness on one trip from being carried over to the next. In most cases where running time data was obtained on more than three trips, observed running times were within three minutes of MBTA book times.[11]

In addition to good on-time departure performance, buses also remain on or close to schedule throughout the route, which is important considering the large number of transfers from the Green Line. At Newton Centre, where these transfers occur, all buses were observed arriving within three minutes of the scheduled time.

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ten or more times greater than the resulting savings in vehicle hours. These figures are based upon that informal standard.

[11]For more detailed information, see Technical Supplement 1, Vehicle Trip Time Summaries.

4. Routes 53 & 54

Route 53 Roberts - Newton Corner via Waltham Center
Route 54 Waverley Square - Newton Corner via Waltham Center

ROUTE PROFILES

Route 53 operates between the Roberts area of Waltham near Brandeis to Newton Corner via the Waltham Hospital, Waltham Center, West Newton, and Newtonville (see Figure 4-1). Service via Waltham Center and West Newton makes the route very indirect between Roberts and Newton Corner, with resulting travel times of approximately 30 minutes.

Route 54 operates between Waverley Square in Belmont and Newton Corner, also by way of Waltham Center, and then along the same alignment as Route 53 to Newton Corner (see Figure 4-2). The alignment of Route 54 is more indirect than that of Route 53, totaling 8.5 miles between Waverley Square and Newton Corner. Geographically, the two areas are less than two miles apart.

Service on both routes is infrequent, with 60 minute headways throughout most of the day (see Tables 4-1 and 4-2). On the "trunk" portion of the combined alignment (between Waltham Center and Newton Corner), however, the two routes are scheduled so that they run alternating trips. As a result, effective headways between Waltham Center and Newton Corner are 30 minutes, with the exception of some AM peak trips that are as close as 15 minutes apart. With the exception of some early and late trips, Route 53 and 54 trips are through-routed to Boston via Route 304.1.

Ridership on both routes is low (830 trips per day on Route 53 and 650 per day on Route 54) and most riders are transit dependent. Route 53 meets normal MBTA boardings per vehicle mile and vehicle hour standards, but Route 54 is within standard only because it qualifies for lower standards due to the large number of transit dependent riders (more than 75 percent without an automobile available and more than 15 percent over 65 years old).

Most riders of both routes live in either Waltham or Newton (mostly West Newton or Newtonville). From Waltham, the largest groups of work trips

Figure 4-1

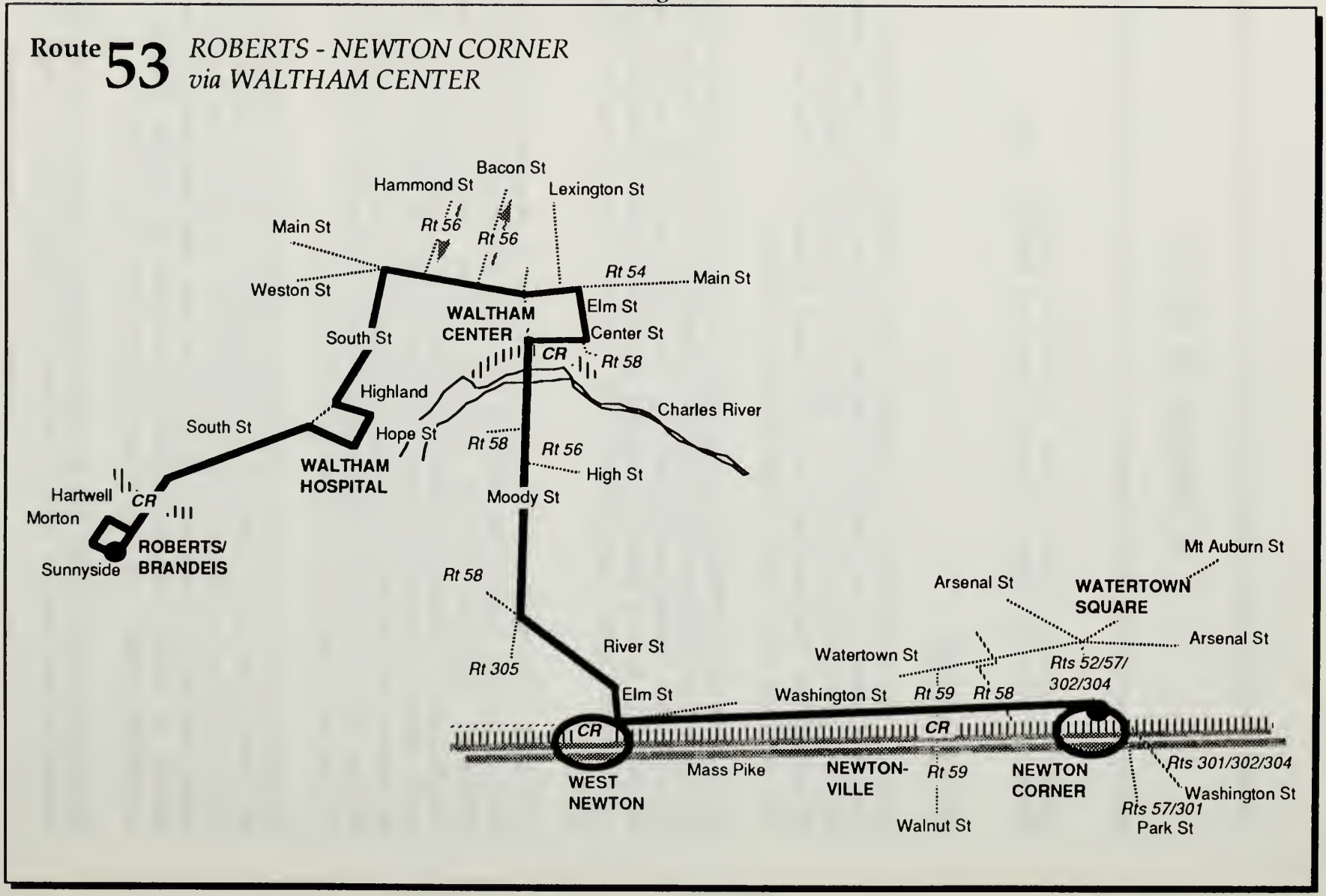
Route 53 ROBERTS - NEWTON CORNER via WALTHAM CENTER
Bacon St
Hammond St
Lexington St
Main St
Rt 56
Rt 56
Rt 54
Main St
Weston St
WALTHAM CENTER
Elm St
South St
Center St
CR
Rt 58
Highland
Charles River
South St
Hope St
Rt 58
Rt 56
WALTHAM HOSPITAL
High St
Hartwell
CR
Morton
Moody St
ROBERTS/ BRANDEIS
Sunnyside
Rt 58
Mt Auburn St
Arsenal St
WATERTOWN SQUARE
Arsenal St
River St
Watertown St
Rts 52/57/ 302/304
Rt 305
Elm St
Washington St
Rt 59
Rt 58
CR
CR
Rts 301/302/304
Mass Pike
NEWTON-VILLE
Rt 59
NEWTON CORNER
Washington St
WEST NEWTON
Rts 57/301
Walnut St
Park St

Figure 4-2

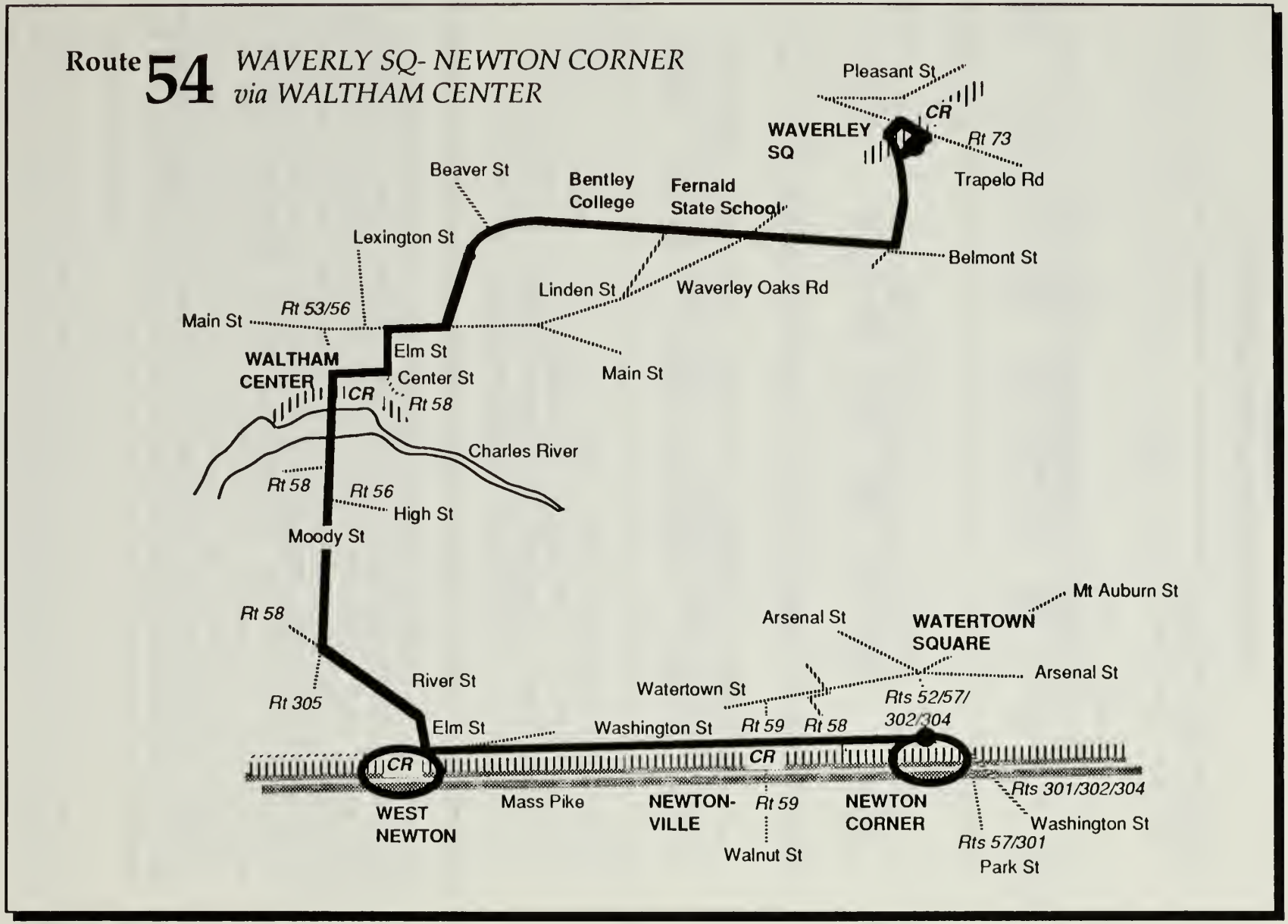
Route 54 WAVERLY SQ- NEWTON CORNER via WALTHAM CENTER
Pleasant St
CR
WAVERLEY SQ
Rt 73
Trapelo Rd
Beaver St
Bentley College
Fernald State School
Lexington St
Belmont St
Linden St
Waverley Oaks Rd
Main St
Rt 53/56
WALTHAM CENTER
Elm St
Center St
CR
Rt 58
Main St
Charles River
Rt 58
Rt 56
High St
Moody St
Rt 58
Rt 305
River St
Elm St
Arsenal St
WATERTOWN SQUARE
Mt Auburn St
Arsenal St
Watertown St
Rts 52/57/ 302/304
Washington St
Rt 59
Rt 58
CR
CR
Rts 301/302/304
Washington St
WEST NEWTON
Mass Pike
NEWTON-VILLE
Rt 59
Walnut St
NEWTON CORNER
Rts 57/301
Park St

Table 4-1
Route 53 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:15AM - 7:00PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 53	7.7	30	38	60	60	60	60	229.5	19.8

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 53	830	3.7	3.3	4.9	4.1	42.1

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 53	$261,390	$79,456	$181,934	30.4%	79.9¢

Other
Percent of passengers 65 or older: 10.1%
Percent without a car available for trip: 85.5%
Peak Load Points: Inbound: Washington St before Newtonville.
Outbound: Washington St past Newtonville.

are made to the Financial District or Government Center areas of Boston, or to various locations outside of the WESTBus corridor. From West Newton, almost half of all work trips are to and from Newtonville, while from Newtonville, most trips are to Cambridge, the Back Bay, the Financial District, or to outside of the study area. Because so many trips are to and from outside of the immediate area, most trips involve a transfer (53 percent of Route 53 and 59 percent on Route 54). Most transfers are with Route 304.1 due to the through-routing (a total of 340 per weekday), accounting for 45 percent of all transfers. Transfers from the two routes are also made with Routes 52 (15 per day), 57 (160), 58 (15), 59 (35), 61 (50), 70 (30), 73 (45), and 302 (60), and ten transfers per day are made between the two routes.

Table 4-2
Route 54 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:20AM - 7:10PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 54	8.5	28	48	60	60	60	60	238	18.4

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 54	650	3.8	2.0	2.4	3.9	35.5

Financial Statistics (Annual - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 54	$254,378	$56,838	$197,540	22.3%	$1.11

Other
Percent of passengers 65 or older: 17.8%
Percent without a car available for trip: 78.8%
Peak Load Points: Inbound: Between Newtonville and Newton Corner.
Outbound: Between Newton Corner and Newtonville.

Trip purpose characteristics of the two routes do vary, with Route 54 carrying a higher percentage of work trips than Route 53 (61 percent versus 47 percent). Much of this difference is due to student ridership. Both routes serve universities, but ridership on Route 53 to Brandeis is much higher than that on Route 54 to Bentley. School trips account for 22 percent of Route 53 ridership, but only four percent for Route 54.

SERVICE COVERAGE

Overall Assessment

Travel patterns of Route 53 and 54 riders are significantly different from those who work in the service area. From the areas served by the two routes (South

Waltham, Central Waltham and North Newton), most work trips are between South Waltham and Central Waltham, or to the Financial District/Government Center areas and the Back Bay. Routes 53 and 54 carry many trips to downtown Boston, but relatively few within Waltham or to the Back Bay. On a broader basis, considering all transit service in the WESTBus corridor, transit achieves a high mode split among work trips to downtown Boston from Central Waltham, South Waltham and North Newton (64 percent), but does much more poorly to other areas. For trips between South Waltham and Central Waltham, the transit mode split is four percent.[11]

Part of the reason for the low transit usage between South and Central Waltham is that there is little direct service. At present, in order to travel between Central Waltham and the area of South Waltham served by Route 53, it is necessary to make a transfer with Route 54 in Waltham Center. However, because Routes 53 and 54 are scheduled to operate alternate trips between Waltham Center and Newton Corner, the transfer requires a wait of 15 to 35 minutes. To better serve these trips, and to provide service that more closely parallels travel patterns within the areas served by the two routes would require major restructuring.

In addition, there are a number of unserved major trip attractors north of Route 54 between Waltham Center and Waverley Square. These include the Army Corp of Engineers, Metropolitan State Hospital, the Fernald School, and the Middlesex County Hospital. Many of the jobs at these institutions are low paying and employers there have experienced difficulty in recruiting employees, presumably due to the lack to transit service. New service to this area could be a source of new ridership, but would also require a fairly major re-routing.

Lastly, there is an oversupply of service on both Route 53 and 54 during most periods of the day. The two routes operate along the same alignment between Newton Corner and Waltham, but because they branch apart past Waltham Center and because of already long headways, it would be difficult to reduce service levels without making other alignment changes. This is particularly true during the mid-day where combined headways are 30 minutes between Waltham Center and Newton Corner and peak loads range from eight to eleven. However, 30 minute trunk headways translate into 60 minute headways beyond Waltham Center, beyond which further increases are not possible. As a result, to permit headways to be lengthened between Waltham Center and Newton Corner, service on the outer end of either Route 53 or Route 54 would have to be eliminated or significantly restructured.

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[11]Based on 1980 Census Journey-to-Work data.

Improved Service Coverage within Waltham - New Routes A and B

Improved service between South Waltham and Central Waltham could be provided without significantly affecting existing service to other areas through a re-alignment of the Routes 53 and 54 as shown in Figure 4-3. In effect, two new routes would be created to replace Routes 53 and 54. The first route ("Route A") would operate between Waltham Center and Newton Corner along what is now the "trunk" portion of Routes 53 and 54 service between Waltham Center and Newton Corner. This route would continue to serve most of the trips now served by Routes 53 and 54. The second route ("Route B") would operate between Roberts and Watertown Square via Waltham Center and Waverley Square. This route would combine the outer segments of Routes 53 and 54 (beyond Waltham Center) and would also extend the outer segment of Route 54 from Waverley Square to Watertown Square via Trapelo Road, White Street, Waverley Street and Main Street. The route would serve Brandeis University and Bentley College, commercial/retail areas in Waltham Center, Waverley Square and Watertown Square, and residential areas in the Roberts area of Waltham, between Waltham and Waverley Square and in Watertown between Waverley Square and Watertown Square. Further, the route could be through-routed with either Route 302 or 304 in Watertown Square to provide direct service to Newton Corner and either Copley Square or downtown Boston.

Projected Ridership By re-aligning the routes in this manner, a significantly larger market could be directly served.[12] Based on the 1980 US Census data, the two current routes directly serve a work trip market of slightly less than 4,000 trips per day. With the route changes discussed above, this market could be expanded to nearly 6,000 trips per day. With the larger market, based on the characteristics of Routes 53 and 54 and transit usage in the Waverley, Newton and Waltham areas, and assuming similar headways to those which exist currently, ridership on the revised routes could total 1,815 trips per day. As shown in Tables 4-3 and 4-4, this would be an increase of 23 percent over a current combined total of 1,480 trips on Routes 53 and 54. On Route A from Waltham Center to Newton Corner, assuming a continuation of through-routing with Route 304.1 in Newton Corner, and unchanged headways, ridership would be 1,130 per day. On Route B, total ridership would be approximately 690 per day.

With these new routes, 1,250 of 1,480 current trips currently made on Routes 53 and 54 would be unaffected. However, along the outer ends beyond

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[12]Directly served refers to the number of trips with *both* trip ends within one-quarter of a mile of the route. For Routes 53 and 54, since nearly all trips are through-routed to downtown Boston, the Financial District and Government Center are also considered to be directly served.

Figure 4-3

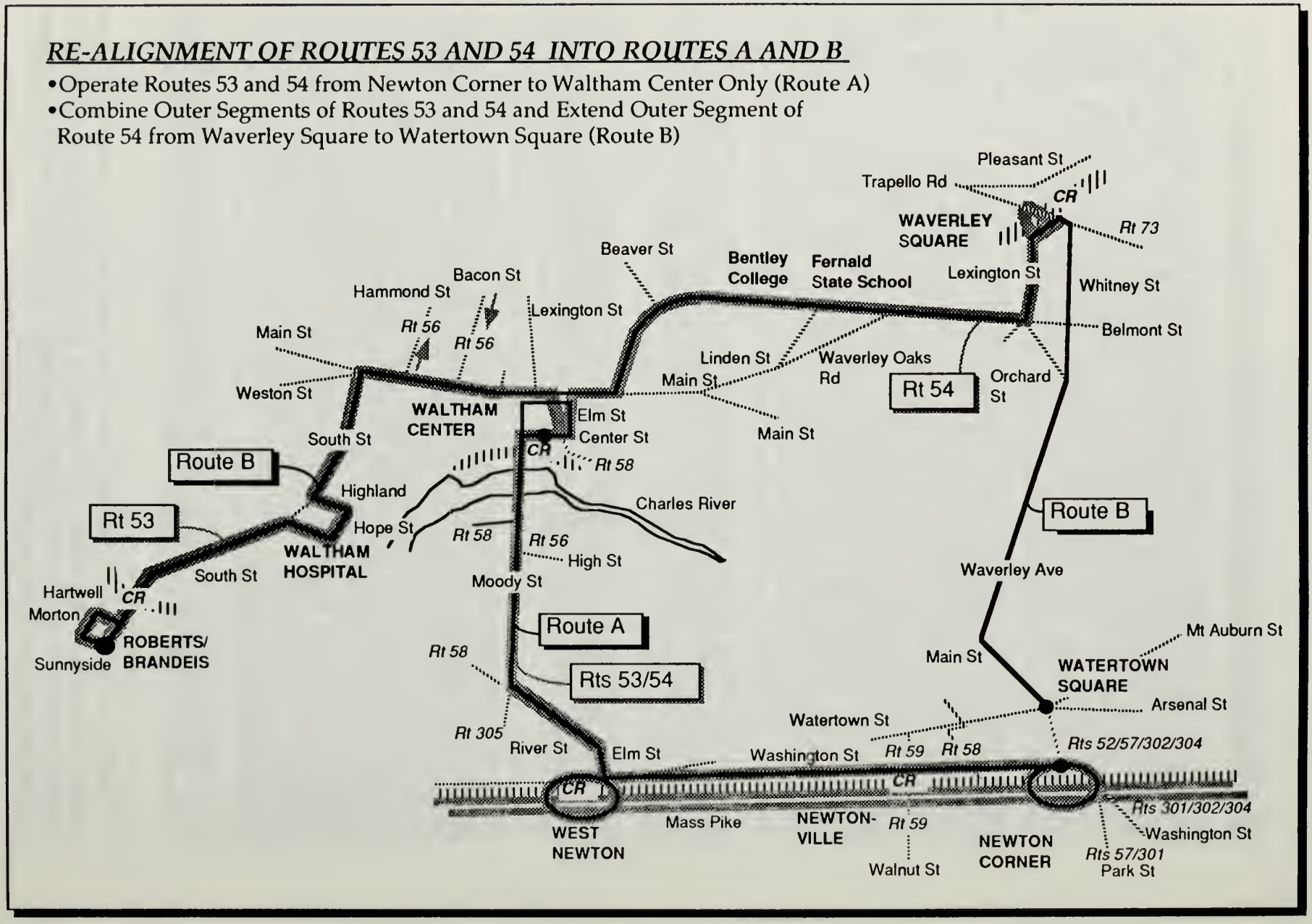
RE-ALIGNMENT OF ROUTES 53 AND 54 INTO ROUTES A AND B
•Operate Routes 53 and 54 from Newton Corner to Waltham Center Only (Route A)
•Combine Outer Segments of Routes 53 and 54 and Extend Outer Segment of Route 54 from Waverley Square to Watertown Square (Route B)
Pleasant St
Trapello Rd
CR
WAVERLEY SQUARE
Rt 73
Beaver St
Bentley College
Fernald State School
Lexington St
Whitney St
Hammond St
Bacon St
Rt 56
Rt 56
Lexington St
Main St
Belmont St
Linden St
Waverley Oaks Rd
Rt 54
Orchard St
Main St
Weston St
WALTHAM CENTER
Elm St
Center St
Main St
South St
CR
Rt 58
Route B
Highland
Charles River
Rt 53
Hope St
Rt 58
Rt 56
High St
WALTHAM HOSPITAL
South St
Moody St
Route B
Waverley Ave
Hartwell
Morton
CR
ROBERTS/ BRANDEIS
Sunnyside
Route A
Mt Auburn St
Rt 58
Main St
WATERTOWN SQUARE
Rts 53/54
Arsenal St
Watertown St
Rt 305
River St
Elm St
Washington St
Rt 59
Rt 58
Rts 52/57/302/304
CR
CR
Rts 301/302/304
Mass Pike
NEWTON-VILLE
Rt 59
Washington St
WEST NEWTON
NEWTON CORNER
Rts 57/301
Park St
Walnut St

Table 4-3
Projected Weekday Ridership on Replacement Route 53/54 Service Compared to Existing Ridership

	Actual Ridership	Estimated Ridership	Percent Difference
Route 53	830		
Route 54	650		
Route A		1,125	
Route B		690	
Total:	**1,480**	**1,815**	**+22.6%**

Table 4-4
Weekday Ridership Impacts of New Services, by Segment

	Existing		Alternative	
	Rt 53	Rt 54	Rt A	Rt B
Ridership with Both Trip Ends on Outer Segments Only				
•Between Roberts-Waltham Ctr	110	--	--	110
•Between Waverley-Waltham Ctr	--	145	--	145
Subtotal:	110	145	--	255
Ridership with Both Trip Ends Between Waltham Center and:				
•Newton Corner (Local Trips)	440	275	715	--
•Downtown Boston	130	145	280	170
Subtotal:	570	420	995	170
Ridership through Waltham Center Towards Newton Corner/Boston				
•Roberts-Newton Corner (Local)	105	--	65	65
•Roberts-Boston (via Rt 304.1)	35	--	25	25
•Waverley-Newton Corner (Local)	--	45	40	40
•Waverley-Boston (via Rt 304.0)	--	30	0	0
Subtotal:	140	75	130	130
Ridership Between Roberts and Waverley/Watertown Squares	10	10	--	135
Total:	**830**	**650**	**1125**	**690**

Waltham Center, 150 of 830 trips now made on Route 53 and 70 of 650 trips now made on Route 54 would involve a transfer between Routes A and B at Waltham Center. Approximately 28 percent of these transfers would be the second transfer required to complete an existing trip, and nearly all would be expected to be lost. This, combined with expected losses due to increased wait time for trips that would involve only one transfer, would likely result in the loss of 100 of these 230 trips.

On Route A, other than increased transfers (from Route B), passenger loads and travel patterns would be very similar to those of existing service on Routes 53 and 54. On Route B, 255 of 690 trips would be existing trips now made on the outer segments of Route 53 and 54 that would be unaffected by the route changes, while 130 would be existing trips made through Waltham Center and upon which a transfer would be newly imposed. In addition, there would also be 135 new trips using direct service through Waltham Center between Roberts and Waverley Square and between Waverley Square and Watertown Square. Through-routed service to Boston via Route 304 would also be used for 170 trips per day.

Scheduling and Cost Impacts To provide service levels on Routes A and B comparable to those now being provided on Routes 53 and 54 would require AM peak headways of 20 minutes on Route A and 40 minutes on Route B and, throughout the rest of the day, 30 minutes on Route A and 60 minutes on Route B. This would require 58 one-way trips per day on Route A, and 32 one-way trips per day on Route B, which would increase operating costs by approximately $146,000 per year.

As with existing service, these service levels would provide more service than needed based on passenger loads. As shown in Table 4-5, peak loads during peak periods would range from 20 to 30, well below seated capacity. To provide a lower level of service, while retaining the ability to coordinate Routes A and B with each other (to serve up to 115 transfers per day) and with other routes, headways could be increased to 30 and/or 60 minutes.

Based on passenger loads, 60 minute headways would be sufficient on both routes throughout the day, and would result in the largest cost and vehicle savings (also see Table 4-5). In total, the operating deficit could be reduced by $69,100 per year, and one less vehicle would be required. However, on Route A, 60 minute headways would be a large increase from the 15 to 30 minute headways currently provided on the trunk portion of the route between Waltham Center and Newton Corner. This increase would reduce ridership there by 300 trips per day, and eliminate all of the gains achieved by the alignment change. Further, 60 minute headways would increase passenger wait times by a total of 80 hours, or 16 hours for each hour of vehicle time

Table 4-5
Service and Cost Statistics for Route A and B Alternatives

	Peak Dir Headways	One-Way Vehicle Trips	Pass. Trips	Peak Load	Vehicles Required	Annual Oper Cost	Annual Fare Rev	Operating Deficit
1. Existing Service on Rts 53 & 54								
•Route 53								
AM Peak	38	8	225	24	2			
Mid-day	60	15	425		2			
PM Peak	60	5	155	23	2			
All Day		28	830		2	$261,390	$79,456	$181,934
•Route 54								
AM Peak	48	7	225	24	2			
Mid-day	60	14	250		2			
PM Peak	60	4	130	25	2			
All Day		25	650		2	$254,378	$56,838	$197,540
•Total		53	1,480		4	$515,768	$136,294	$379,474
2. Routes A & B with Comparable Service Levels to Routes 53 & 54								
•Route A								
AM Peak	20	16	330	21	3			
Mid-day	30	28	510		2			
PM Peak	30	10	210	23	2			
All Day		54	1,125		3	$339,714	$103,689	$236,025
•Route B								
AM Peak	40	8	200	18	2			
Mid-day	60	14	310		2			
PM Peak	60	4	130	27	2			
All Day		26	690		2	$317,082	$71,660	$245,422
•Total		80	1,815		5	$656,796	$175,349	$481,447
3. Lowest Cost Alternative								
•Route A								
AM Peak	60	6	240	41	1			
Mid-day	60	14	375		1			
PM Peak	60	4	155	42	1			
All Day		24	825		1	$191,024	$78,189	$112,835
•Route B								
AM Peak	60	6	165	20	2			
Mid-day	60	14	310		2			
PM Peak	60	4	130	27	2			
All Day		24	655		2	$300,332	$68,685	$231,647
•Total		48	1,480		3	$491,356	$146,874	$344,482
4. 30 Min Peak Headways on Route A/60 Min Off-Peak Headways								
•Route A								
AM Peak	30	10	275	28	2			
Mid-day	60	14	375		1			
PM Peak	30	10	210	23	1			
All Day		34	935		2	$233,524	$92,485	$141,039
•Route B								
AM Peak	30	10	230	17	3			
Mid-day	60	14	310		2			
PM Peak	30	10	190	16	2			
All Day		34	780		3	$333,832	$79,310	$254,522
•Total		68	1,715		4	$567,356	$171,795	$395,561

that would be saved. In the PM peak, the increase in passenger wait time would be 12.9 hours for each hour of vehicle time saved.

Alternatively, thirty minute peak period headways on Route A would reduce potential ridership losses, and provide a level of service between Waltham Center and Newton Corner much closer to that now provided. Ridership on Route A with 30 minute peak period, and 60 mid-day headways, would be 935 trips per day, or 110 trips per day higher than with 60 minute peak period headways. Peak loads during peak periods would be relatively low at 23 to 26. However, as further discussed in Chapter 11 on Route 305, ridership on Route A could be further increased by integrating this service with that provided on Route 305.[13]

On Route B, which would replace service along the outer ends of Routes 53 and 54, and where service levels are already low, 60 minute headways would result in a decrease in service only during the AM peak. However, based on projected ridership levels, an increase in AM peak headways would result in a relatively large increase in passenger wait time compared to vehicle savings. In this case, there would be 18.3 hours of additional wait time for each hour of vehicle time saved (1.5 total hours saved). In order to coordinate Route B service with Route A, the alternative to 60 minute headways during peak periods would be 30 minute headways.[14] This would result in the attraction of an additional 90 trips.

Thirty minute peak period headways on Route B would require the operation of five round trips in each of the peak periods, as compared to four in the AM peak and two in the PM peak to maintain current service levels. Although peak loads with 30 minute headways would be low (16 to 17), there would be significant decreases in passenger wait times. In the AM peak, 12.7 hours of wait time would be saved for each hour of additional vehicle time, and in the PM peak, the passenger wait time savings would be 10.7 hours for each hour of additional vehicle time (4.5 hours total).

In total, the operation of Routes A and B at 30 minute peak period and 60 minute off-peak headways would increase ridership by 235 trips per day over current levels. However, this would also require the deployment of one

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[13]In summary, this would involve through-routing all local routes serving Waltham Center to Boston, with those trips alternating with Route 305 trips. Since travel times on through-routed local trips are essentially the same as on Route 305, this would allow much existing Route 305 ridership to be shifted to local routes with excess capacity, which in turn would allow service to be reduced on Route 305.

[14]Schedule coordination between Routes A and B would be necessary to serve 115 existing Route 53 and 54 trips that would require a transfer with revised service. Without coordinated schedules, most of these trips would be lost.

additional vehicle and increase the operating deficit by $15,000. If vehicle requirements were held constant, a ridership increase would still be possible by operating Route A at 30 minute peak, 60 minute off-peak headways, and Route B at 60 minute headways all day. This would increase ridership by 110 trips per day and reduce the operating deficit by $7,100.

Replacement of Route 53 or 54 with Route 58 Re-Routed to Brandeis/Roberts or Waverley

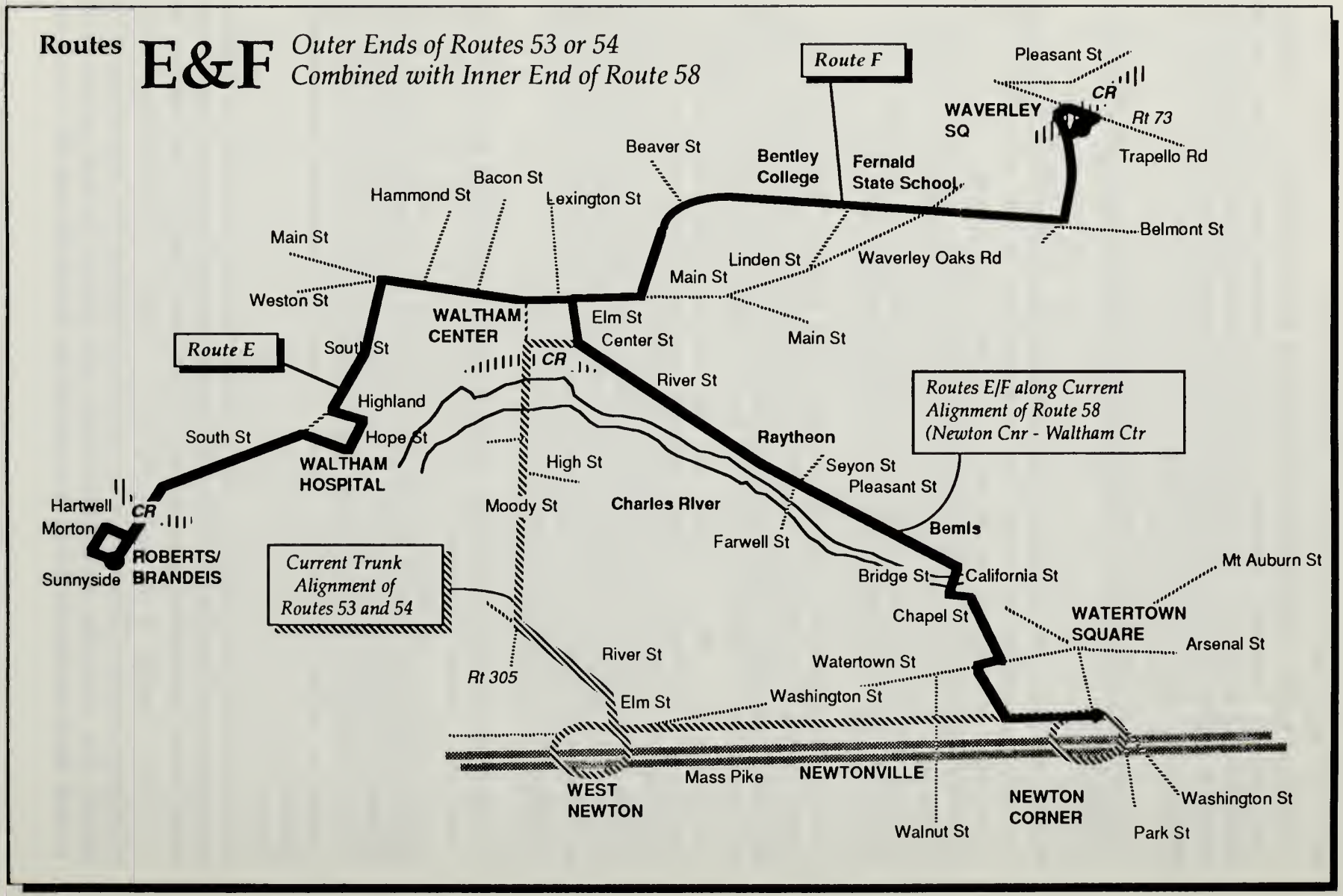
As an alternative to the Route A and B changes, savings could be realized through a connection of the outer end of Route 53 or 54 with the inner half of Route 58. As discussed in the section on Route 58, ridership on Route 58 between Waltham Center and Auburndale is low, and under certain circumstances, could be eliminated. If this were done, Route 58 could be extended along the outer alignment of either Route 53 or 54, which would then allow for one of those routes to be eliminated (see Figure 4-4).

The major benefit of this change would be that mid-day headways between Waltham Center and Newton Corner could be increased along Moody, River, Elm and Washington Streets to 60 minutes, saving $85,000 to $88,000 per year. Currently, both Route 53 and 54 operate along this same alignment alternating trips at 60 minute mid-day headways, resulting in effective headways of 30 minutes. These headways are shorter than necessary to serve demand, but could not be increased beyond 60 minutes without providing extremely long headways along the outer end of each route. As a result, either Route 53 or 54 would have to be combined with another route in order to reduce service between Waltham Center and Newton Corner without also reducing or eliminating service along the outer ends.

The outright elimination of either route would not be feasible since it would leave areas beyond Waltham Center to either Roberts or Waverley unserved. A re-routing of one Route between Waltham Center and Newton along another alignment, in itself, would not result in any real reduction in service. However, the connection of the outer end of a shortened Route 58 with the outer end of Route 53 or 54 would allow one of those routes to be eliminated altogether, while still providing service to nearly all areas that are currently served.

During peak periods, significant reductions in service would not be possible. Instead, service on the route that continued to operate in its present form would need to be increased to either 20 minute or 30 minute headways (from a current average of 38 to 48 minutes) to make up for service on the eliminated route. This would be necessary because the remaining route would then carry the peak period loads now carried by both routes, with overall loads similar to those now carried on Routes 53 and 54. However,

Figure 4-4


Routes E&F
Outer Ends of Routes 53 or 54
Combined with Inner End of Route 58
Route F
Route E
Pleasant St
CR
WAVERLEY SQ
Rt 73
Trapello Rd
Beaver St
Bentley College
Fernald State School
Bacon St
Hammond St
Lexington St
Belmont St
Main St
Linden St
Waverley Oaks Rd
Weston St
WALTHAM CENTER
Elm St
Center St
Main St
South St
River St
Highland
Hope St
South St
WALTHAM HOSPITAL
Raytheon
High St
Seyon St
Pleasant St
Hartwell
Morton
Moody St
Charles River
Farwell St
Bemis
ROBERTS/ BRANDEIS
Sunnyside
Routes E/F along Current Alignment of Route 58 (Newton Cnr - Waltham Ctr
Current Trunk Alignment of Routes 53 and 54
Bridge St
California St
Mt Auburn St
Chapel St
WATERTOWN SQUARE
Arsenal St
River St
Watertown St
Rt 305
Elm St
Washington St
Mass Pike
NEWTONVILLE
WEST NEWTON
NEWTON CORNER
Washington St
Walnut St
Park St

these changes would not affect costs or vehicle requirements: vehicles now deployed on Routes 53 and 54 would be shifted to the remaining route, and vehicles now providing service on Route 58 would be shifted to Route E or F.

As shown in Table 4-6, assuming a coordinated transfer in Waltham Center, existing service levels during peak periods, and all local trips through-routed to Boston, total ridership would be essentially the same with either alternative. However, slightly fewer new transfers would be required by combining the outer end of Route 54 with a shortened Route 58. Both options would result in a loss in ridership of approximately 140 trips per day compared to current service on Routes 53 and 54.

Table 4-6
Ridership on Routes E/54 and F/53 Combinations

	Replace Route 53 w/ Route E & Route 54		Replace Route 54 w/ Route F & Route 53	
•Pax Unaffected	445	755	450	765
•Pax Affected by 60 Min Mid-day Headways	0	500	0	500
•Loss due to 60 Min Mid-day Headway	--	-135	--	-135
•New Transfers Req'd	65	65	30	30
•Loss due to Transfer	-5	-5	-5	-5
Totals:	**505**	**1,180**	**475**	**1,155**

The similar ridership levels and low number of transfers are a function of the small number of trips made through Waltham Center on Routes 53 and 54 that are not to either Newton Corner or Boston, both of which would continue to be directly served. As a result, although many trips would be served by a new route, they would be unaffected in terms of transfers, wait time or travel time. Most of the ridership losses that would occur would be during the mid-day periods, where headways would be reduced from 30 minutes to 60 minutes.

Service to Army Corp of Engineers, Fernald School and Hospitals along Trapelo Road

In Waltham, the "Trapelo Road Coalition," consisting of large employers along Trapelo Road, including the Army Corp of Engineers, the Fernald State School, Metropolitan State Hospital (Met State), and the Middlesex County Hospital, has requested that service be provided between their area and Waverley Square. This area employs nearly 4,500 workers (see Table 4-7), but

is not presently served by transit. These employers have recently experienced difficulties in recruiting employees, partly due to the lack of transit service.

Table 4-7
Employment[15]

Employer	Number of Employees	
Corp of Engineers	480	
Other Agencies @ Corp of Eng (Army, USAF, Dept of Agriculture)	520	
Federal Records Center	70	(200 Summer)
Fernald State School	2,500	(2,350 filled)
Met State	800	
Middlesex County Hospital	400	
Total:	**4,470**	

Re-routing of Route 54 To provide service to the hospital area with Route 54, service would have to be re-routed between Waltham Center and Waverley. The most likely way in which this could be done would be to re-route service as shown in Figure 4-5 from Beaver Street to Forest Street to Trapelo Road. At Waverley Square, connections could then be made with Route 73, which operates between there and Harvard Square. In this manner, the hospital area would be linked with Cambridge and the rapid transit system.

The hospital area would be difficult to effectively serve with transit due to a number of factors. First, the most realistic alignment would not be able to serve Met State or the Middlesex County Hospital well. However, more direct service to those two institutions would not be possible without routing the bus in an extremely circuitous manner, or forcing it to backtrack. In addition, a long walk would also be required to the Fernald School due to its location back from Trapelo Road. Further, Route 54 would directly serve a relatively low proportion of the trips, meaning that one or more transfers would be required on most trips. Due to long headways on Route 54, these transfers would be difficult. This, combined with ample parking in the area would result in most employees with a car driving instead of taking the bus. Finally, no evening or night service is provided on Route 54, so that second and third shifts would not be served.

If employees of the hospital area exhibited the same characteristics of other Route 54 riders, only 20 work trips would be expected to be attracted from outside of the local area. However, up to 44 percent of the hospital area

[15]September 1987, as reported by employers.

employees are from Boston, Cambridge and Somerville.[16] Residents from these areas, in general, utilize transit to a greater extent than do residents of Waltham and Newton. In addition, many of the hospital jobs are low paying, so that there would tend to be a higher level of transit dependency among these workers. As of 1980, 17 percent of the Cambridge residents working in "South" or "Central" Waltham[17] used transit. Most of these trips were presumably via Route 70, which provides direct service from Central Square. From Somerville and parts of Boston for which data was available (Roxbury, Parker Hill and the South End), transit usage to the same areas of Waltham was only 1.9 percent. From these areas, access to Route 70 is much more difficult, often requiring more than one transfer, which would explain the lower transit usage.

With Route 54 re-routed to the hospital area, two transfers would be required for the large majority of riders (one to Route 73 and another to Route 54), so that transit usage of Cambridge residents to the hospital area would more likely parallel that of Somerville and Boston residents. On this basis, and assuming that due to a very high level of transit dependency among these workers, long walks to Met State and the Middlesex County hospital would not affect ridership, approximately two percent of the Cambridge, Somerville and Boston employees would be likely to use Route 54 to the hospital area. This would translate into 85 work trips per day made by 40 to 45 employees.

In addition to work trips, other trips would be made for non-work purposes. In this area, non-work trips would be made by hospital volunteers, hospital out-patients, and by persons who lived at the hospitals. Based on the non-work trip-making rates of other Route 54 riders, approximately 35 trips per day would be made to the hospital area.

The re-routing would also have an impact on existing riders. Present service between Forest and Beaver Streets and Waverley Square would be eliminated, which would leave 70 existing trips unserved. The new alignment, however, would serve neighborhoods along Forest Street and Trapelo Road that currently are not served. Based on the trip making characteristics of existing Route 54 riders, these residents would make 110 trips per day on Route 54 for both work and non-work purposes, for a net gain of 40 trips from these markets.

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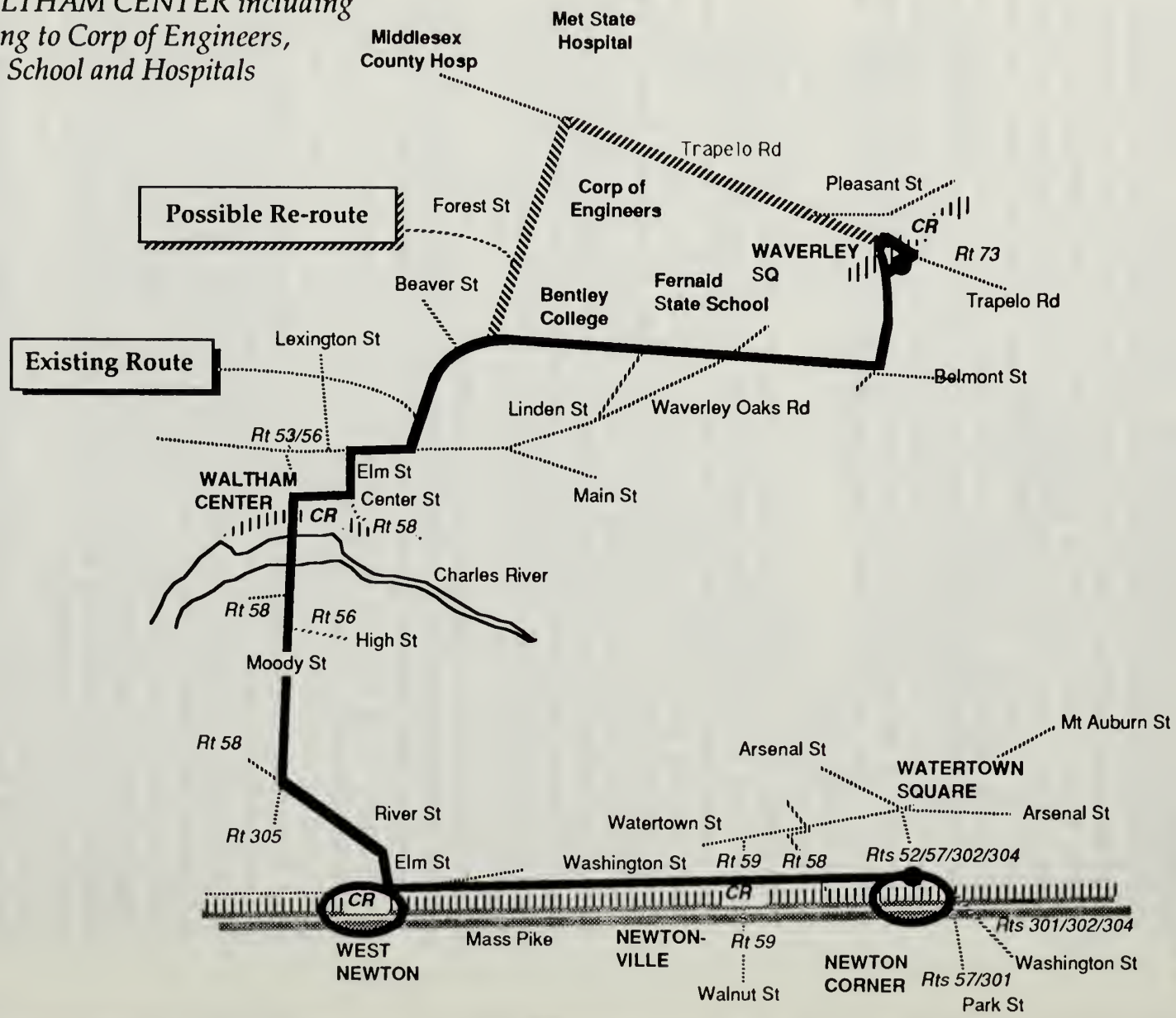
[16]Based on information provided by the Fernald School, the largest groups of employees live in Cambridge (13%), Dorchester (12%), Waltham (11%), Somerville (6%) and Mattapan (5%). At Met State and the Middlesex County Hospital, town of residence data was not available, but since Met State recruits heavily in Dorchester and Roxbury, and since many of the jobs are similar in nature, it is likely that the distribution is similar to that of the Fernald School.

[17]Based on the WESTBus subarea definitions. The Trapelo Road Hospital area is considered part of Central Waltham.

Figure 4-5

Route 54 *WAVERLY SQ- NEWTON CORNER via WALTHAM CENTER including re-routing to Corp of Engineers, Fernald School and Hospitals*



Including both market segments, ridership to Trapelo Road institutions and ridership by area residents, ridership would then increase by up to 160 trips per day. This would include 120 new trips to the hospital area, plus 110 new trips made by area residents, offset by a loss of 70 trips made by existing riders.

The re-routing could be operated with the same amount of equipment, and, unless the span of service were increased, operating costs would remain essentially the same. The mileage of the re-routed segment would be approximately 2.6 miles, as compared to the present alignment of about 2.5 miles. Further, operating speeds over the re-routed segment would be as fast or faster than over the existing alignment, so that cycle time problems should not occur. If the span of service were increased, each additional round trip would cost approximately $15,100 per year to operate, or $75,500 if hourly service were operated through midnight.

Other Options In addition to a re-routing of Route 54, other options to provide service to the hospital area would be an extension of some Route 73 trips, a re-routing of Route 61, or an employer operated shuttle.

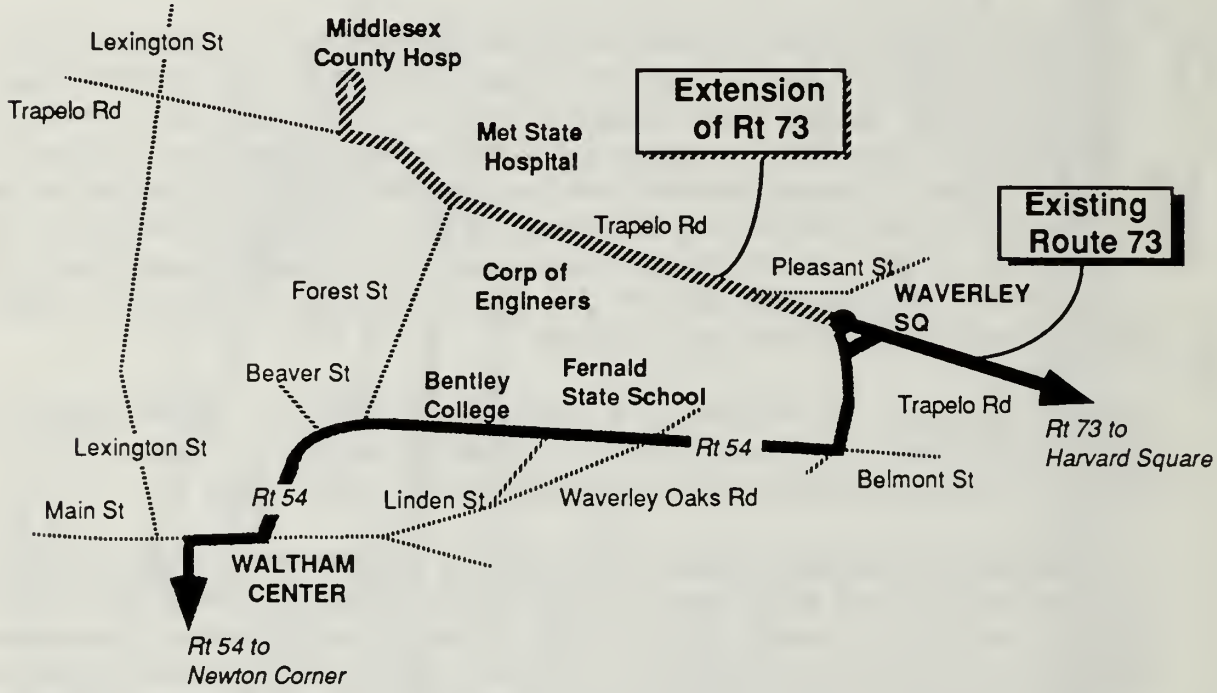
Extension of Route 73 Trips As previously mentioned, up to 44 percent of the hospital area employees are from Boston, Cambridge and Somerville. An extension of some Route 73 trips would provide a direct connection from the rapid transit system at Harvard Square, which would eliminate one transfer. Further, an extension could provide better service coverage to Met State and the Middlesex County Hospital than Route 54 (see Figure 4-6). An extension of Route 73 trips could also serve all three working shifts at the hospital due to its longer operating hours (from 4:43 AM to 1:17 AM).

The elimination of the transfer to Route 54 would likely attract additional riders who would ride by choice. With the extension of some Route 73 trips, it would be reasonable to expect that transit could achieve a similar mode split to the hospital area as it does to areas served by Route 70. In this case, up to 17 percent of the trips made from Cambridge would use Route 73. Including trips from Cambridge, as well as Boston and Somerville, up to 175 work trips would be made to the hospital area. (The actual number would be dependent upon the level of service provided. The 175 figure assumes a level of service equivalent to Route 70.)

To provide a level of service roughly equivalent to Route 70, at least one Route 73 trip would need to be extended every 30 minutes. On an all day basis, the extension of 40 round trips would cost $204,000 per year, and require the deployment of one additional vehicle.

Aside from cost, a major disadvantage of this alternative is that the extension of some Route 73 trips would also require the substitution of

Figure 4-6
Extension of Route 73 to Middlesex County Hospital



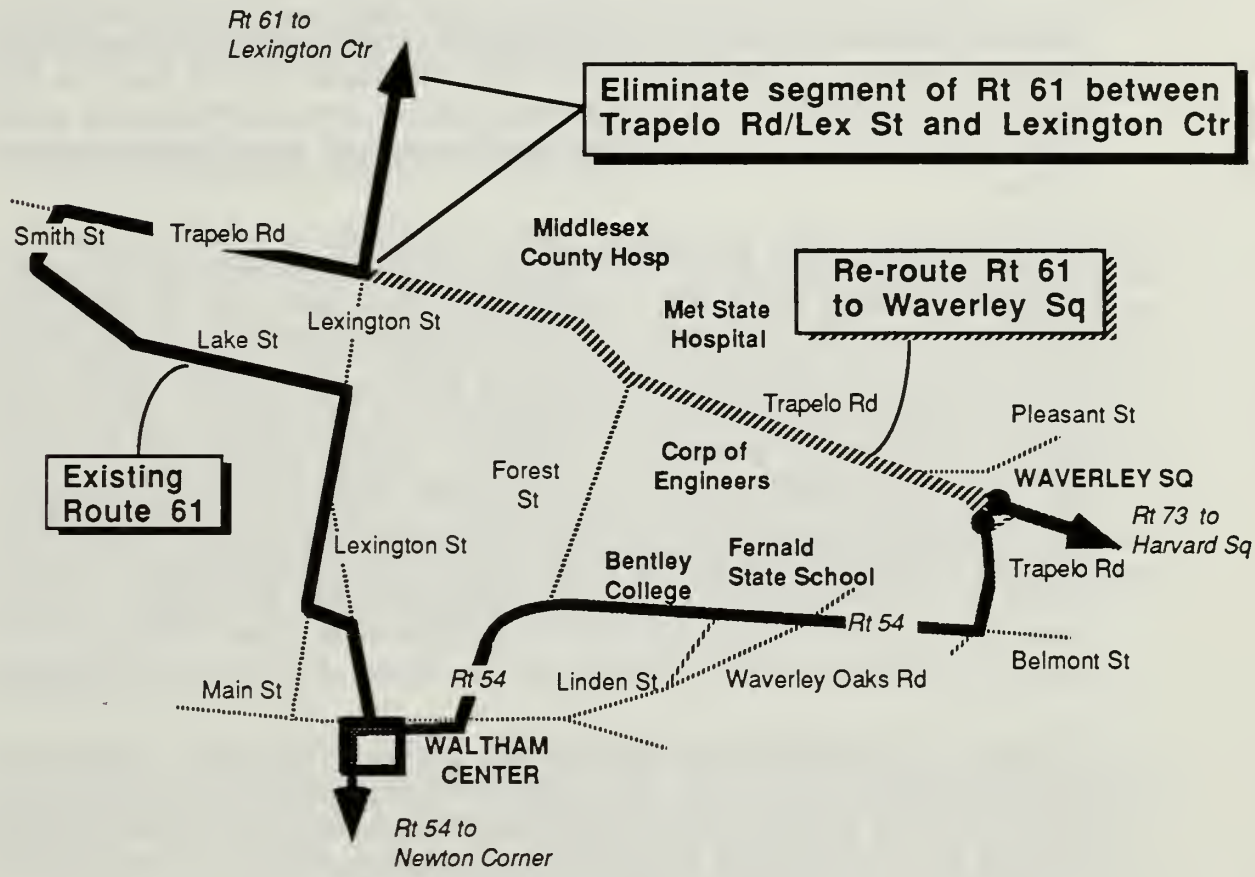
diesel buses for electric trolley buses on extended trips. This would cause a number of operational and scheduling problems on Route 73, as well as on Route 77A, with which Route 73 is interlined.

Re-routing of Route 61 Route 61 currently operates between Lexington Center and Waltham Center. Based on data collected for the Northwest Corridor Service Study[18] in the Fall of 1983, most of the ridership on the route is between Waltham Center and Waltham Plaza (at the intersection of Lexington Street and Trapelo Road), with only 125 trips per day made between there and Lexington Center. In this case, an option would be to eliminate the segment between Waltham Plaza and Lexington Center and re-route the same amount of service to Waverley Square through the hospital area (see Figure 4-7).

A re-routing of Route 61, as with an extension of Route 73, could provide much better service coverage to the hospital area than could a re-routing of Route 54. However, as with Route 54, the level of service on Route 61

[18]Northwest Corridor Service Study, Cambridge Systematics, Inc., January 1985.

Figure 4-7
Re-routing of Route 61 from Lexington Center
to Waverley Square via Hospital Area



is very low (65 to 70 minute headways throughout the day), and the span of service is short (6:05 AM to 5:32 PM). As a result, a re-routing of this service would also serve only one of three shifts.

Ridership figures for a re-routing of Route 61 would be similar as with a re-routing of Route 54. Approximately 120 trips would be made to and from the hospital area, and 110 new trips would be made by area residents. These new trips, however, would be offset by the loss of 120 existing trips made between Waltham Plaza and Lexington Center, so that the net gain would be 110 trips per day.

At present, one bus is deployed on this route throughout the day. With the route revised to operate via the hospital area to Waverley Square, the one way route mileage would be reduced from 8.7 miles to 7.5 miles. This

would allow headways to be reduced from between 65 and 70 minutes to 60 minutes while still only requiring one vehicle. With this change, the cost of reduced headways would offset the mileage savings, so that overall costs would be relatively unchanged with the same span of service. Additional trips would increase operating costs by approximately $12,000 per year per trip, or $60,200 per year for hourly service through midnight.

Employer Operated Shuttle A non-MBTA option would be an employer operated shuttle. This could consist of scheduled service such as that operated by MASCO in the Longwood Medical Area or be similar to the Mass General Hospital shuttle that operates to and from North Station in Boston.

In the Trapelo Road hospital area, an employer operated shuttle from Waverley Square could provide better service than any of the MBTA options in a number of ways. First, a shuttle could provide service directly to the door of each institution, whereas MBTA bus service would drop riders off along Forest and/or Trapelo Roads, which in most cases would require a fairly long walk to the buildings. Second, shuttle service could provide more frequent service and more flexible scheduling. One shuttle, for example, could provide service every 20 minutes, whereas MBTA service on Routes 54 or 61 would operate at 60 minute headways. Service could also be better tailored to shift changes at the hospitals, including second and third shifts, than MBTA service would be. Third, shuttle service could be provided to employees at a lower cost than MBTA service.

The cost of an employer operated shuttle would depend upon the amount of service provided, but in most cases would be relatively inexpensive. Assuming six round trips scheduled around each of the three shift changes and a round trip mileage of seven miles, shuttle service could be provided for approximately $1,700 to $2,000 per month.[19]

Overall, all of the MBTA options for service would be difficult to implement, or provide relatively ineffective service and take service away from other areas. Due to the nature of the jobs in the hospital area, transit connections would be needed over a long span of service, which would increase costs by $60,200 to $204,000. Further, because of the shift nature of work at the hospitals, little ridership would be anticipated between the end of the PM peak and the next shift change so that the productivity of evening service on

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[19]Costs based upon information supplied by CARAVAN for Commuters, Inc., and includes the cost to lease a van, gas, maintenance, and insurance. Also included is the cost of a driver at $7.00 per hour. The lower figure includes a $300 per month "Route 128 Vanpool Incentive Program (VIP)" subsidy available through CARAVAN.

these routes would be very low. By comparison, private shuttle service would cost $20,400 to $24,000 per year.

In terms of total cost and the quality of service that would be provided those traveling to and from the hospital area, a private shuttle would be more appropriate than MBTA service. However, the cost of a private shuttle would be borne by the hospital area employers, while MBTA service would be provided at no direct cost to those employers.

LEVEL OF SERVICE - EXISTING SERVICE

Currently, loads on all trips on both routes are below capacity[20] with the exception of one school trip on Route 53. Average loads during peak periods range from 22 to 34 total passengers. To more efficiently serve these passenger loads, a lower level of service than is presently provided would be sufficient. During the mid-day and PM peak, headways on the two routes are already at 60 minutes, so, based on MBTA maximum headway standards, further reductions would not be possible with the present service configurations. However, during the AM peak, when headways on both routes are 30 to 60 minutes, and 10 to 30 minutes on the common segment of the two routes, minor adjustments could be made to distribute service more evenly throughout the period and to simplify schedules.

AM Peak

At present, round trip running times in the AM peak for both routes average 99 minutes (including Route 304.1, with which both routes are through-routed). With a cycle time of 120 minutes and headways at 30 to 60 minutes, three buses are now required for each route.[21] Based on the 120 minute cycle time, which is necessary to insure adequate recovery time, headways could instead be set at either 40 minutes or 60 minutes, as shown in Table 4-8, or specific trips could be eliminated. Sixty minute headways would, in effect, mean the elimination of one trip between 6:30 AM and 7:30 AM on each route.[22] Forty minute headways would essentially mean the reallocation of existing service on the two routes over the AM peak at even intervals.

At 60 minute headways, operating costs would be reduced by up to $30,300 per year and two fewer vehicles would be required, but AM peak ridership would

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[20]MBTA Maximum Load Standards as a percent of seated capacity: peak 30 minutes-140%; total peak period-120%; other periods-100%.

[21]Due to inter-lining with Routes 304 and 305, four vehicles are actually deployed on Route 53.

[22]On Route 53, the 6:40 outbound and 7:20 AM inbound trips; on Route 54, the 6:50 AM outbound and the 7:30 inbound trips.

Table 4-8
Routes 53 and 54 - AM Peak Headway Adjustment Alternatives

	Change Impact on Vehicles Required	Peak Load	Δ Pax in VSH's Provided	Pax Wait Time (hrs)	Time/ Δ Veh Hours
Route 53					
Current (38 Min.Avg)	3	24			
40 Minutes	3	25	0.0	0.0	0.0
60 Minutes	2	39	-2.0	+33.7	16.9
Route 54					
Current (48 Min.Avg)	3	24			
40 Minutes	3	25	0.0	0.0	0.0
60 Minutes	2	32	-1.5	+20.2	13.5
Route 53 & 54 Combined					
Current	6	24			
40 Minutes	3	25	0.0	0.0	0.0
60 Minutes	2	36	-3.5	+53.9	15.4

decrease by approximately 14 percent, or 65 trips. With this ridership decrease, peak loads would average 36 passengers throughout the AM peak, still below seated capacity on most trips. However, an increase to 60 minute headways would result in a relatively large increase in wait time for remaining passengers. For the two routes combined, there would be an increase of 15.4 hours of passenger wait time for each hour of vehicle time saved. Further, on Route 54, for the increased headways to result in vehicle time savings would likely require the elimination of the 7:30 AM trips. In both directions, these trips carry the highest ridership in the period (49 total trips inbound, 47 outbound).

With even 40 minute headways, the same amount of service could be extended more evenly throughout the AM peak, and schedules would be simplified, while operating costs would remain essentially the same. At present, most inbound service is bunched into a 55 minute period between 6:50 AM and 7:45 AM, where five trips provide service at an average of 14 minute headways. This results in longer headways of 25 to 35 minutes before and after that time. As shown in Table 4-9, while ridership is heaviest on trips departing between 6:50 AM and 7:45 AM, the same number of passenger trips could be served by one fewer vehicle trip during that time, with average peak loads still below the seated capacity of 35. This would allow one trip to be moved to later in the period, which should increase ridership between 7:45 AM and the end of the period. Overall, this change should result in a small ridership increase of three percent, or about 15 trips per day.

Table 4-9
Existing AM Peak Inbound Route 53/54 Service

Route	Departure Time	Mins to Next Bus	Total Ons	Peak Load
53	6:25	25	14	9
53	6:50	10	22	15
54	7:00	20	33	26
53	7:20	10	55	39
54	7:30	15	49	26
53	7:45	25	46	33
54	8:10	35	31	20

PM Peak

With AM peak headways at or close to 40 minutes, a decrease in PM peak headways to 40 minutes to match AM peak headways could result in ridership increases. On both routes, most home based trips are inbound in the AM peak and outbound in the afternoon. Most riders walk to the route at the outer end, but over half transfer to another bus at the inner end. As a result, riders are able to time their arrival to the route in the AM peak more precisely than in the afternoon, so that most mode choice decisions are probably governed more by the 60 minute PM peak headway than by the AM peak headway. In this case, any increase resulting from a reduction of headways in the PM peak should result in a corresponding increase in the AM peak.

On this basis, on Routes 53 and 54 combined, a reduction in headways to 40 minutes would increase ridership by up to 120 trips per day. This would require one additional vehicle to be deployed on each route in the PM peak, at an additional cost of $30,000 per year.

RELIABILITY

Route 53

Since MBTA book times were last calculated, mean running times have increased slightly, as shown in Table 4-10. Although the increases have been small (four minutes total), the one minute increase in the inbound direction coupled with normal running time variability has resulted in lateness problems on Route 304.1 trips that follow Route 53 trips (when observed,

Table 4-10
Route 53 Weekday Running Times
(All Day, in minutes)

	MBTA Book Time	Observed Running Times Mean	STD
Inbound:	31	32	4.4
Outbound:	28	31	5.3
Total:	59	63	

observed, six of 15 Route 304.1 that followed Route 53 trips were three or more minutes late). In the outbound direction, 17 minutes of recovery/layover time is scheduled, so that the three minute increase in running time has not affected inbound departures. Further, on a round trip basis, the total cycle time for combined Route 53/304.1 trips of 120 minutes remains sufficient to insure reliable service throughout the day. Therefore, only minor re-scheduling to account for longer running times is needed to alleviate most lateness problems.

Route 54

On Route 54, current running times are three to five minutes shorter than MBTA book times (see Table 4-11). As a result of the shorter running time in the inbound direction, many trips must hold at Newton Corner before continuing on to Boston instead of operating straight through. However, as with Route 53, the combined cycle time of 120 minutes remains appropriate, and only minor re-scheduling is necessary to reduce the number of early arrivals at Newton Corner.

Table 4-11
Route 54 Weekday Running Times
(All Day, in minutes)

	MBTA Book Time	Observed Running Times Mean	STD
Inbound:	36	33	3.9
Outbound:	35	30	4.2
Total:	71	63	

5. Route 56

Route 56 Waltham Highlands - Newton Corner via Waltham Center

ROUTE PROFILE

Route 56 operates between Waltham Highlands, a residential area north of Waltham Center, and Newton Corner. The route also serves Waltham Center, the Swedish Home for the Aged in Newton, and Newtonville. A variation of the route, 56.1, provides three one-way trips daily (two inbound; one outbound) to the Cedarwood area (see Figure 5-1). Commuter rail connections are possible on both variations at Waltham Center and Newtonville, but are used by fewer than five persons per day. At the present time, most peak period, peak direction Route 56 trips are through-routed to Boston via Route 304.1, but most other service is not.

As with other WESTBus local routes, ridership and service levels are low. On Variation 56.0, service operates at only 60 minute headways throughout the day. However, including the three Route 56.1 trips, service is provided over most of the alignment at 30 minute headways during the AM peak in the inbound (peak) direction, and at 30 to 60 minute headways in the PM peak in the outbound direction. Total ridership on the two variations combined is slightly less than 600 trips per day, the second lowest of all WESTBus routes.

Despite low ridership, Route 56 does meet MBTA service standards (see Table 5-1). This is primarily due to the relative shortness of the route (5.5 miles each way), as the number of passengers carried per trip is low throughout the day (20 or less, except for peak periods in the peak direction). As with other WESTBus local routes, there is a high level of transit dependency: 18 percent of all riders are under 18, 14 percent are 65 or over, almost 75 percent do not have a car available, and 43 percent do not have a driver's license.

Most riders of Route 56 are residents of Newton (60 percent) or Waltham (31 percent), with most trips made to and from Boston and Newton. Sixty percent of all trips are for work purposes and 17 percent are for school purposes. Relatively few trips are made in the reverse direction to Waltham, and as a result, ridership is heavily peaked in the inbound direction in the AM peak, and in the outbound direction during the school and PM peak periods.

Figure 5-1

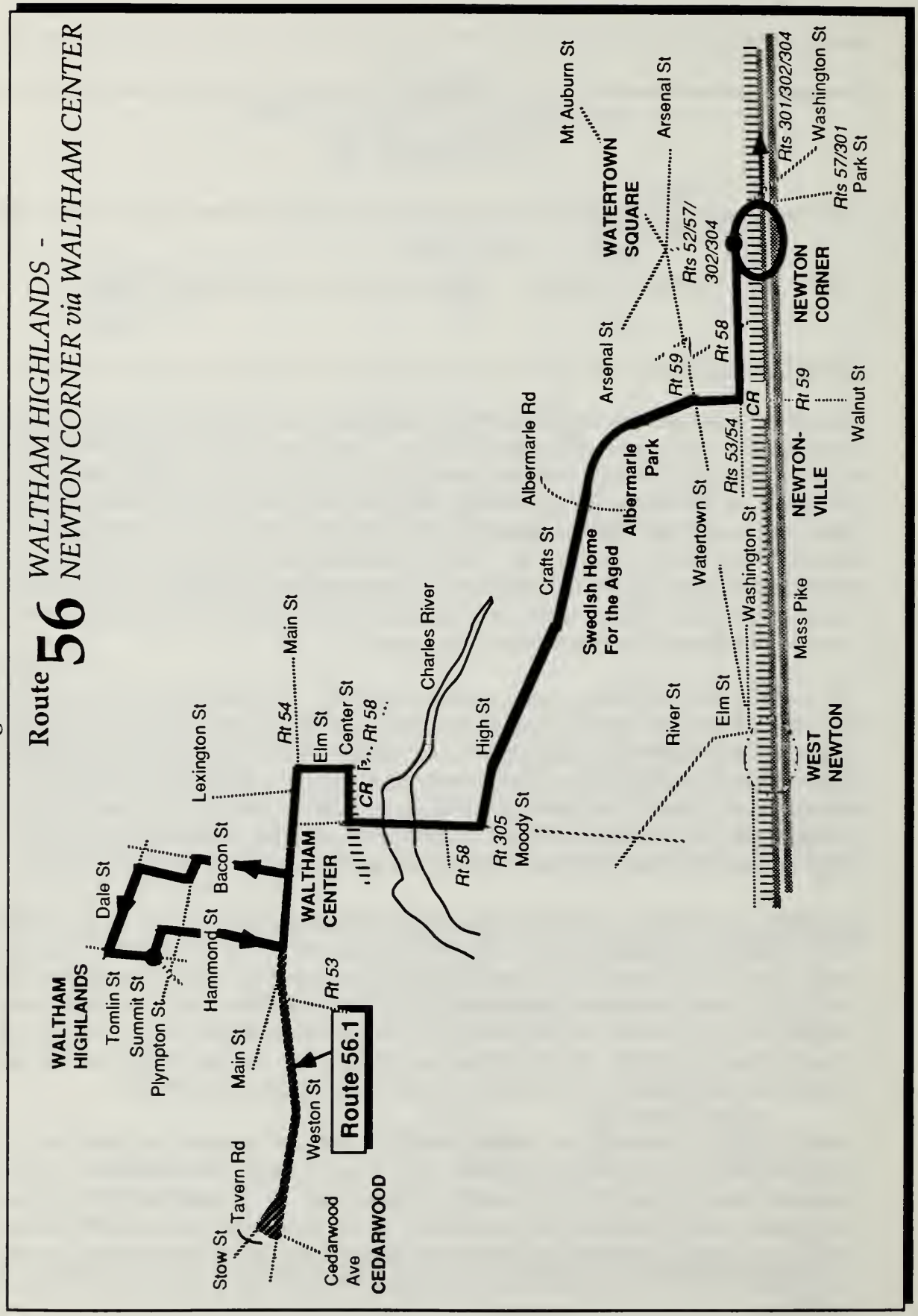
Route 56
WALTHAM HIGHLANDS - NEWTON CORNER via WALTHAM CENTER
WALTHAM HIGHLANDS
Tomlin St
Summit St
Plympton St
Dale St
Hammond St
Bacon St
Lexington St
Main St
Rt 54
Elm St
Center St
CR
Rt 58
WALTHAM CENTER
Charles River
Rt 58
High St
Rt 305
Moody St
Crafts St
Albermarle Rd
Swedish Home For the Aged
Albermarle Park
Arsenal St
Mt Auburn St
WATERTOWN SQUARE
Arsenal St
Rts 52/57/ 302/304
Rt 59
Rt 58
Watertown St
Rts 53/54
CR
Rt 59
NEWTON CORNER
Rts 301/302/304
Washington St
Rts 57/301
Park St
River St
Elm St
Washington St
Mass Pike
NEWTON-VILLE
Walnut St
WEST NEWTON
Main St
Rt 53
Route 56.1
Weston St
Tavern Rd
Stow St
Cedarwood Ave
CEDARWOOD

Table 5-1
Route 56 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:15AM - 7:15PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 56.0	5.5	29	60	60	60	60	60	158.8	14.5
Rt 56.1	5.1	3	2T[21]	--	--	1T	--	15.4	1.5
Total:		**32**	**30**	**60**	**60**	**45**	**60**	**174.2**	**16.0**

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 56.0	510	4.9	2.8	3.1	4.5	35.4
Rt 56.1	70	3.6	--	--	6.4	46.7
Total:	**580**	**4.6**	**2.8**	**3.1**	**4.8**	**36.4**

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 56All	$206,950	$49,910	$157,040	24.1%	$1.01

Other
Percent of passengers 65 or older: 14.4%
Percent without a car available for trip: 74.5%
Peak Load Points: Inbound: Walnut St. at Linwood Ave.
Outbound: Walnut St. at Page Rd.

Nearly all riders (96 percent) walk to and from the route at the outer end of their trip, but half involve a transfer at the inner end. Of these transfers, approximately 130 are made daily with Route 304.1, involving approximately 24 percent of all trips. Other transfers involve Routes 57 (50 per day), 59 (10), 61 (5), 70 (5), 301 (5), and 302 (20).

[21]T = Number of Trips; i.e, 2T means that there are only two trips in the period.

SERVICE COVERAGE

Overall Assessment

Relative to other WESTBus local routes operating in Waltham, Route 56 serves a small work trip market, which largely accounts for the route's low ridership. The small market, in turn, is a function of the short length of the route and lower density residential area at the outer end of the route (Waltham Highlands). Based on 1980 US Census data, the local work trip market for the major variation, Route 56.0, is approximately 1,440 work trips per day, while for Route 56.1, it is 19 percent larger at 1,710 one-way trips per day. For trips to Boston's Financial District/Government Center and Back Bay/Park Square areas, the work trip markets are, respectively, 2,160 and 2,230 one-way trips per day. Within these markets, transit achieves a 29 to 31 percent share overall. Although nearly all of these trips are to Boston, within the local market, transit does achieve a seven to eight percent share, which is relatively high for the Waltham-Newton area.

Unlike many of the other local routes, the alignment of Route 56 is very direct between the two terminals at Waltham Highlands and Newton Corner. Between Waltham Center and Newton Corner, the route provides the only service within walking distance to densely populated residential areas (9,000 to 11,000 residents per square mile in Waltham). Considering these characteristics, plus the fact that all large nearby activity centers are served, this alignment remains the best available for the route.

Service Beyond Waltham Center

Along the outer ends of both variations, ridership is low. On the major variation (Route 56.0), only 46 daily trips are made on the 1.5 mile loop through Waltham Highlands. However, as this is the only service to Waltham Highlands, it would be difficult to eliminate. On the Route 56.1 variation to Cedarwood, only five passenger trips are made daily on the segment beyond Main Street. Since Route 70 (Cedarwood - Central Square, Cambridge) also follows the same alignment between Cedarwood and Waltham Center, this variation could be eliminated without leaving existing riders unserved.

With the elimination of Route 56.1 service between Waltham Center and Cedarwood, those trips could either be eliminated altogether, shifted to Route 56.0, or Route 56.1 trips could operate only between Waltham Center and Newton Corner. As discussed in the next section, 30 minute headways should be provided during peak periods. However, 30 minute headways are justifiable only on the basis of passenger loads on the trunk portion of the route, and would not be needed on the Waltham Highlands loop.

Although additional service to Waltham Highlands is not needed, the operation of Route 56.1 only as far as Waltham Center would not result in any significant cost savings, and would result in inefficient vehicle use. With or without service being through-routed with Route 304, the same number of vehicles would be needed with service only to Waltham Center as to Waltham Highlands. Shorter headways could be provided with the same number of vehicles, but the shorter headways on the Route 56.1 trips could not be evenly integrated with Route 56.0 trips operating at 60 or 30 minute headways.[22] As a result, for operational reasons, the Route 56.1 trips should operate all the way to Waltham Highlands as Route 56.0 trips. This would also result in a ridership increase of 20 trips per day. There would be no change in vehicle requirements and the change in operating costs would be negligible.

Through-Routing of All Trips with Route 304.1

From within the existing market, additional increases in ridership would occur if all trips were through-routed with Route 304.1. During peak periods, when most trips are through-routed, 30 percent of all trips involve "transfers" with Route 304. During off-peak periods, when trips are not through-routed, transfers fall to six percent of total ridership. Most of this decrease appears to be the result of the imposition of the transfer at Newton Corner. On Routes 53 and 54, which are through-routed throughout the day, the difference in transfer rates between peak periods and non-peak periods is much smaller.[23] Based on the transfer rate on Route 54, which has similar work/non-work trip characteristics, ridership would increase by 25 trips per day with the through-routing of all trips. A transfer would also be eliminated for 90 existing riders.

LEVEL OF SERVICE

On Routes 56.0 and 56.1 combined, service operates at 30 minute headways in the AM peak, 30 to 60 minute headways in the PM peak, and at 60 minute headways during all other periods with the exception of two inbound trips during the school period that are 15 minutes apart. These headways are more than sufficient to meet demand during all periods.

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[22]Currently, two vehicles provide through-routed service on Routes 56/304 at 60 minute headways. The elimination of the Waltham Highlands loop would shorten round trip running times by 15 minutes from 80 - 84 minutes to 65 - 69 minutes. Two vehicles would still be needed for 60 minute headways, but 40 minute headways could also be provided. The same basic relationship holds for non-through routed trips.

[23] Route 53: 18% peak; 21% off-peak
Route 54: 28% peak; 14% off-peak

AM Peak

During the AM peak, where service operates at 30 minute headways, peak loads average 22 passengers for the five inbound trips, with a maximum of 37. If headways were reduced to 60 minutes through the elimination of Route 56.1, as they are during other periods, ridership would decline by about 45 trips per day, and peak loads would average 34 passengers, still well below capacity. One fewer vehicle would be required and operating costs would be reduced by $11,000 per year.

However, the increase in headways to 60 minutes would result in a large increase in wait time for remaining passengers. Of 170 total passengers in the AM peak, 125 would likely continue to use the route given 60 minute headways. For these riders, average wait times would increase from an average of 15 minutes to an average of 30 minutes. The total increase in wait time for these passengers would be 31.3 hours, or 15.6 hours for each vehicle hour saved. Due to the large increase in passenger wait times that would occur, AM peak headways should remain at 30 minutes, at least over the trunk portion of the route between Waltham Center and Newton Corner.

PM Peak

As with Routes 53 and 54, most trips are made in the inbound direction during the AM peak, in the outbound direction in the school and PM peak periods, and involve a transfer to another bus at the inner end. As a result, for the same reasons as with Routes 53 and 54, it is likely that the 60 minute PM peak headways govern mode choice decisions to a much greater extent than do the 30 minute AM peak headways. For Route 56, the inclusion of the 5:20 PM Route 56.1 trip results in 30 minute headways from 4:50 PM to 5:50 PM over the trunk portion of the route. To provide 30 minute headways throughout the PM peak, one additional trip would be needed at 4:20 PM. This would result in an increase in ridership of up to 50 trips per day, (approximately 25 on the new inbound trip, and 25 inbound in the AM peak and base periods). If for scheduling purposes, a trip were also added in the inbound direction, 20 additional passenger trips would be attracted, for a total of 70. The decrease in headways would also save current riders 12.8 hours of wait time for the one hour of additional vehicle time expended. The cost to provide the additional service would be $5,470 per year.

Base and School Periods

During the base and school period, service should continue to operate at 60 minute headways, but the extra trip during the school period should be eliminated (the 3:00 PM inbound trip from Waltham Highlands). During both periods, peak loads are very low (14 passengers or lower), but since

service already operates at the minimum headway for this type of service, further headway reductions are not possible. The extra 3:00 PM trip, which precedes the next "normally" scheduled trip by 15 minutes, carries an average of only four passengers. The "regularly" scheduled 3:15 PM departure carries 21 passengers, with a peak load of 10. The 3:15 PM trip could easily carry the load of both trips, thus allowing the 3:00 PM trip to be eliminated.

RELIABILITY

The on-time departure performance of Route 56 is very good. Of the fifty-one Route 56.0 and 56.1 trips ridechecked, only one departed more than three minutes late, and three departed three minutes early. Overall, the observed on-time performance rate for both variations was 92 percent.

Observed running times for Route 56.0 were close to MBTA book times, but averaged three minutes shorter in each direction. Running time variability is also relatively low throughout the route's alignment, and throughout the day. Based on the running time variability, eight minutes of recovery time should be provided for each round trip to ensure at least 90 percent on-time departure performance. On average, only six minutes are scheduled, but because running times are shorter, a total of 12 minutes is actually provided, which is more than adequate.

6. Route 58

Route 58 Auburndale - Newton Corner via Waltham Center

ROUTE PROFILE

Route 58 operates between the Auburndale section of Newton near Route 128 and Newton Corner via Waltham Center (see Figure 6-1). The route also serves residential areas in Waltham as well as Raytheon in Waltham, Bemis in Watertown, and the Nonantum section of Newton. Currently, four inbound and three outbound trips are through-routed with Route 304.1 to provide some direct service to downtown Boston. Connections can also be made to the commuter rail system at Auburndale or Waltham Center, although fewer than five persons per day do so.

Overall, ridership on Route 58 is the lowest of all the WESTBus routes: less than 400 per day. The route does not meet MBTA standards for passengers per vehicle mile during the base or school periods, or for passengers per vehicle hour, nor does it qualify for lower standards on the basis of the percentage of passengers either 65 or older or without a car available (see Table 6-1). However, the income levels of Route 58 riders are the lowest of any of the WESTBus routes (57 percent below $20,000), and 38 percent do not have a driver's license, indicating that the route's ridership is fairly transit dependent.

Most Route 58 riders travel in the inbound direction in the AM peak from Newton and Waltham to Newton or Boston. In the afternoon, the same general pattern is reversed. Approximately 43 percent of all trips involve transfers with other buses, and as with the other local routes through-routed with Route 304.1, most transfers are with Route 304. Of a total of 170 transfers per day, 125 are with Route 304, 15 are with Route 53, 20 are with Route 57, 15 with Route 70, five with Route 301, and ten with Route 302.

Figure 6-1

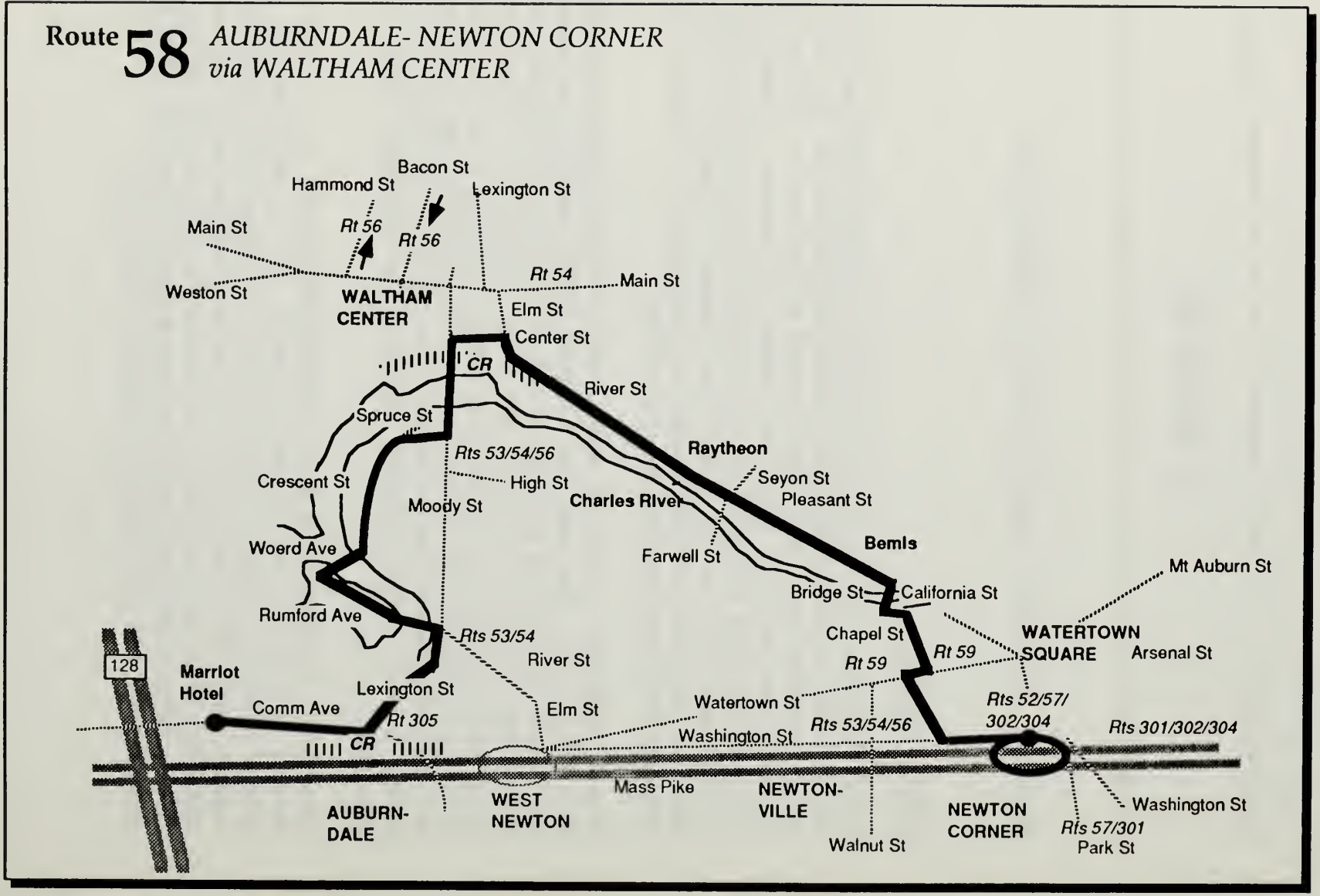
Route 58 AUBURNDALE- NEWTON CORNER
via WALTHAM CENTER
Bacon St
Hammond St
Lexington St
Main St
Rt 56
Rt 56
Rt 54
Main St
Weston St
WALTHAM CENTER
Elm St
Center St
CR
River St
Spruce St
Rts 53/54/56
Raytheon
Crescent St
High St
Seyon St
Pleasant St
Moody St
Charles River
Woerd Ave
Farwell St
Bemis
Mt Auburn St
Bridge St
California St
Rumford Ave
Rts 53/54
Chapel St
WATERTOWN SQUARE
Arsenal St
Rt 59
Rt 59
128
Marriot Hotel
River St
Lexington St
Comm Ave
Rt 305
Elm St
Watertown St
Rts 52/57/ 302/304
Rts 53/54/56
Rts 301/302/304
CR
Washington St
Mass Pike
AUBURN-DALE
WEST NEWTON
NEWTON-VILLE
NEWTON CORNER
Washington St
Walnut St
Rts 57/301
Park St

Table 6-1
Route 58 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:30AM - 7:20PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 58	6.7	28	34	60	60	60	42	187.6	14.0

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 58	390	3.1	1.4	2.3	2.7	28.1

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 58All	$192,410	$39,310	$153,100	20.4%	$1.42

Other
Percent of passengers 65 or older: 7.6%
Percent without a car available for trip: 72.3%
Peak Load Points: Inbound: Chapel St. @ Watertown St. (Nonantum)
Outbound: River St at Newton St. (before Waltham Center)

SERVICE COVERAGE

Overall Assessment

Route 58 serves a total work trip market for local trips and trips to the Financial District/Government Center areas (1,960 and 1,350, respectively). These markets are comparable to those served by Routes 53 and 54, but ridership is 40 to 52 percent lower. The low ridership appears largely attributable to three factors: (1) the route can provide direct service only for relatively short trips (between Waltham Center and the ends of the route) or for trips to

Boston with an outer end no farther out than Waltham Center; (2) for most other trips (within Waltham, or between Auburndale/West Newton Corner and Nonantum/Newton Corner) trips made via Route 58 are very indirect and take much longer than they would by car; and (3) long headways. These characteristics result in a route that competes poorly with other modes in areas where residents have relatively low levels of transit dependency. As a result, those that do ride the bus tend to be those residents with fewer alternatives.

In many respects, Route 58 now operates as two radial routes to Waltham Center that have been combined. On this basis,
existing trips can be categorized as follows: ridership wholly within the Newton Corner to Waltham Center segment,
ridership wholly within the Waltham Center to Auburndale segment, and ridership through Waltham Center on both segments. Ridership within each of these groups is as shown in Table 6-2:

Table 6-2
Route 58 - Weekday Ridership by Segment

	Ridership	% of Total
Newton Corner - Waltham Center only	205	53%
Waltham Center - Auburndale only	65	17%
Through Waltham Center	120	31%
	390	

Most of the route's ridership is completely on the inner segment of the route between Newton Corner and Waltham Center (53 percent). Along this alignment, service is direct, there is no other service within one-quarter of a mile, and the area is fairly densely populated (7,000 to 9,300 residents per square mile in Waltham). In addition to the 205 trips made between Newton Corner and Waltham Center, another 120 trips (31%) also utilized the segment for trips south of Waltham Center. Only 17 percent of all trips are made completely within the segment between Waltham Center and Auburndale. This is due partly to the lower density development along the outer end in Newton which results in a smaller market size, and competition from other routes (Routes 53, 54 and 305).

To provide service that could compete better with the automobile, either headways would have to be shortened and/or more direct service could be provided. Considering current ridership levels, shorter headways cannot be justified, and would not result in significantly higher ridership. To provide more direct service without eliminating service to Waltham Center would

require that a new route be instituted between Auburndale and Newton Corner.

Elimination of Route 58 Service Beyond Waltham Center

Ridership between Waltham Center and Auburndale on Route 58 is low and most of the same area is also served by Routes 53, 54, and 305. By making relatively minor changes to these routes, Route 58 service between Auburndale and Waltham Center could be eliminated, and most of the trips now made on that segment of Route 58 could be shifted to Routes 53, 54 (or Route A) and/or Route 305.[24] This would reduce Route 58 AM peak vehicle requirements by one and operating costs by $83,400, or 43 percent. The changes to other routes that would be required to accomplish this would be as follows:

- Allow local trips to be made on Route 305 between Waltham Center and West Newton. Since Route 305 is within walking distance of Route 58 between Auburndale and Waltham Center, Route 305 could then carry Route 58 trips on this segment during peak periods.

- Through-route the outer end of a shortened Route 58 (operating between Newton Corner and Waltham only) with Route A (if implemented), or Route 305. This would allow most of the trips now made through Waltham Center on Route 58 to continue to be made without a transfer.

Under this scenario, 135 of the 185 trips made on the Waltham Center to Auburndale segment of Route 58 could be served by Routes A, 53, 54 and/or 305. The 50 trips that would be left unserved would be those now made on the outermost segment of Route 58 between Auburndale and Route 128 that would be beyond walking distance of other services. (As discussed in the next section, continued service for these trips would require replacement service along that alignment, which would be relatively expensive to provide.) Of the 135 trips that would be served, up to 90 would require a transfer to the shortened Route 58 in Waltham Center, unless through-routings with Route 305 or A with Route 58 were provided in Waltham Center. Seventy of these transfers could be eliminated by through-routing Route 58 with Route 305 at Waltham Center, and 50 could be eliminated by through-routing Route 58 with Route A.

As shown in Table 6-3, without replacement service between Auburndale and Route 128, ridership on a shortened Route 58 would be 210 to 270 trips per

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[24]Trips made on the Crescent Street segment in Waltham would require a walk to Moody Street, but nearly all would be within one-quarter mile walking distance.

day, depending upon the degree of through-routing provided. At these ridership levels, the performance of a shortened Route 58 would be similar to that of the full route, and continue to be below MBTA performance standards.

Since Route 305 operates within walking distance of Route 58 for a longer distance than do Routes 53 and 54, it could serve more Route 58 trips than the other two routes could. Without mid-day service on Route 305 (as is currently the case), the route could serve 105 existing Route 58 trips, 70 of which would continue on to the shortened Route 58. Forty-five trips between Auburndale and Route 128 would be left

Table 6-3
Weekday Ridership Impacts of Shortened Route 58

	Rt 58 Total	RtA/305 Increase	Total Linked Trips	Trips Unserved /Lost	New Transfers Imposed
•No Change	390	0	390	0	0
•No Thru-Routing	245	70	275	115	40
•Rt 58 with Rt A	265	100	305	85	15
•Rt 58 with Rt 305	285	120	325	65	10

unserved, as well as 30 mid-day trips between Lexington and Rumford Streets and Lexington Street and Commonwealth Avenue (due to the lack of mid-day service).[25] However, 15 of the mid-day trips could be served by Routes A, 53 or 54, but approximately five would be lost due to the imposition of a transfer to Route 58.

Route A or Routes 53 and 54 would serve 80 of the 185 trips now made on Route 58 beyond Waltham Center, 25 less than by Route 305. Up to 65 of these 80 trips would require a transfer at Waltham Center to Route 58. With the implementation of Route A, a through-routing with a shortened Route 58 would eliminate 50 of the 80 transfers. Of the trips not served by Routes A, 53 or 54, 25 would be served by Route 305 if local trips were permitted. A total of 80 trips would be left unserved by this combination, and five to ten trips would be lost due to the imposition of transfers between Routes 58 and 305.

Of the two possible through-routings, through-routing with Route 305 would directly serve more existing riders than with Route A (70 versus 50).

[25]To provide Route 305 service throughout the day, four mid-day round trips would would have to be added at a cost of $71,400 per year, which would offset most of the cost savings that would result from eliminating the outer segment of Route 58.

However, although the through-routing of a shortened Route 58 with Routes 53/54 operating as Route A would serve fewer passengers than with Route 305, it would be less confusing to riders, particularly new and occasional riders, since all Route 58 trips could be through-routed with all Route A trips. Further, Route A would operate on Saturdays, while Route 305 does not. As a result, the same method of operation could be used all six days the routes operate, which would also be less confusing.

Direct Service Between Auburndale and Newton Corner

New service between Auburndale and Newton Corner could serve two functions. First, it would provide direct service from Auburndale to Newton Corner instead of along the current circuitous route through Waltham Center. Second, this route could replace the service that would be eliminated between Auburndale and Route 128 if Route 58 were shortened as discussed above.

As shown in Figure 6-2, the most direct alignment serving the greatest number of potential trips between Auburndale and Newton Corner would be along Commonwealth Avenue to Lexington Street to Auburndale Street to Elm Street, and then along the alignment of Routes 53 and 54 to Newton Corner (as Route "C").[26] However, as also shown in Figure 6-2, a new direct route between these two areas would overlap the service areas of Routes 53, 54, and 305, all of which currently have excess capacity. New direct service for local trips along Washington Street would be provided only for those traveling to and from locations west of West Newton, and new direct service for trips to downtown Boston would be provided only along a half-mile stretch of Commonwealth Avenue beyond Lexington Street. The market for these trips is small, and as a result, the additional ridership generated by the direct service would be less than 70 trips per day.

Due to the small number of new trips attracted, a new route between Auburndale and Newton Corner could not be justified unless other changes were made as well. In this respect, since Route C would also serve many of the trips now made on Routes 53 and 54, or Route A[27] between West Newton and Newton Corner (approximately 230 trips), service could then be reduced on those routes, which would offset much of the cost of the new

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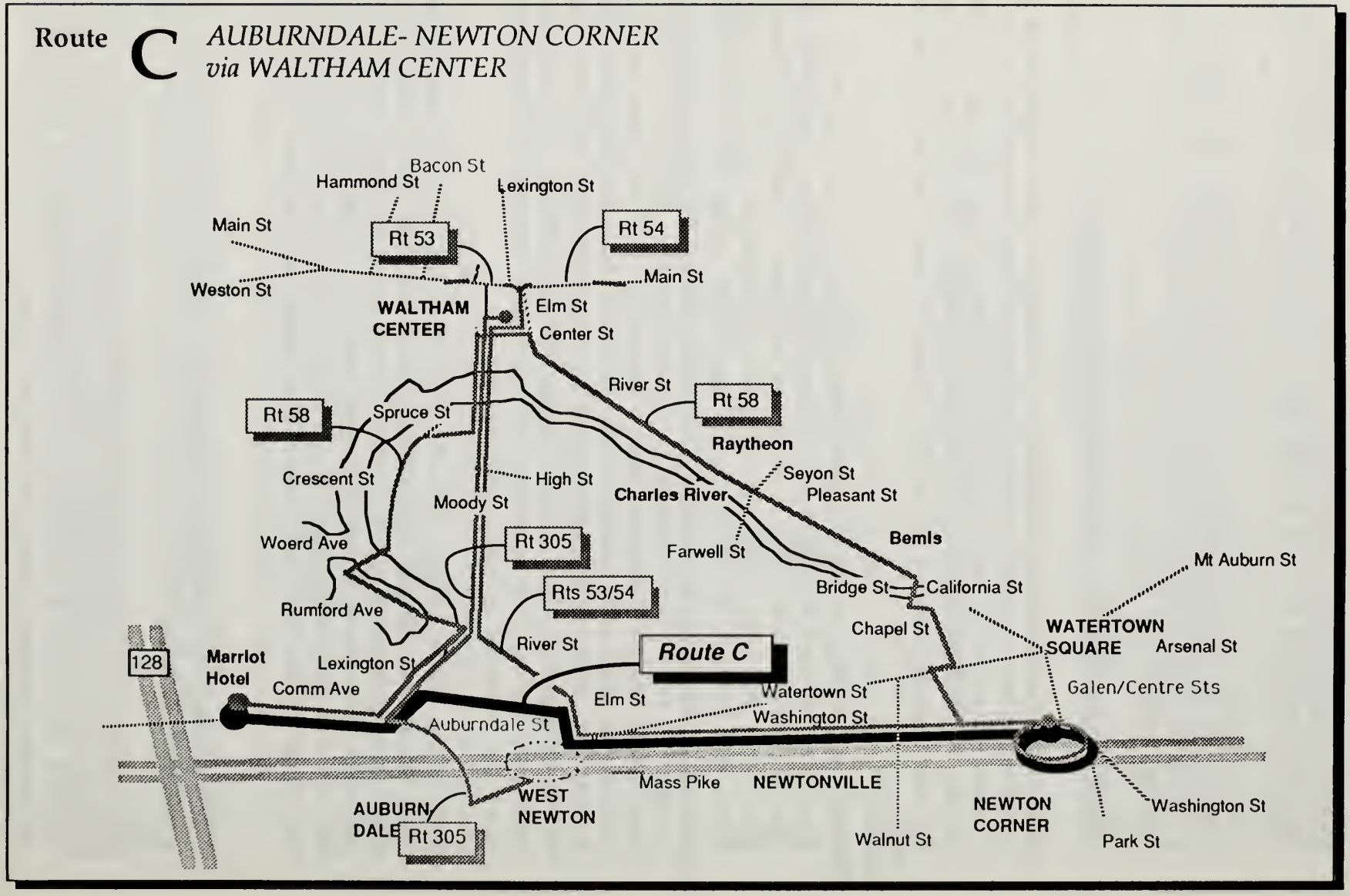
[26]This service could operate as a new local route (as shown in Figure 7), or as a variation of Route 300 beginning at Riverside. See also Chapter 8, Route 300.

[27]As discussed in the section on Routes 53 and 54, an alternative for service changes to those routes would be replacement with two new routes: Routes "A" and "B". Route A would follow the present alignment of Routes 53 and 54 between Waltham Center and Newton Corner.

Figure 6-2


Route C
AUBURNDALE- NEWTON CORNER
via WALTHAM CENTER
Bacon St
Hammond St
Lexington St
Main St
Rt 53
Rt 54
Main St
Weston St
WALTHAM CENTER
Elm St
Center St
River St
Rt 58
Rt 58
Spruce St
Raytheon
Crescent St
High St
Seyon St
Moody St
Charles River
Pleasant St
Woerd Ave
Rt 305
Farwell St
Bemis
Mt Auburn St
Rts 53/54
Bridge St
California St
Rumford Ave
Chapel St
WATERTOWN SQUARE
Arsenal St
128
Marriot Hotel
Lexington St
River St
Route C
Comm Ave
Elm St
Watertown St
Galen/Centre Sts
Auburndale St
Washington St
Mass Pike
NEWTONVILLE
AUBURN DALE
Rt 305
WEST NEWTON
NEWTON CORNER
Washington St
Walnut St
Park St

service. This would result in a reduction in service between Waltham Center and West Newton along the alignment of Routes 53 and 54, but service levels on the most heavily traveled segments of those routes along Washington Street could be maintained or increased.

However, even with a reduction of service on Routes A or 53 and 54, total ridership on Route C would only be 340 trips per weekday (see also Table 6-4). At this ridership level, the performance of the route would be below normal MBTA standards. (However, because Route C would be expected to serve a highly transit dependent market, as do Routes 53 and 54, it would qualify for the lower standards and the lower standards would be met.) At these ridership levels, 60 minute headways would be sufficient throughout the day. Based on a round trip route mileage of 9.2 miles and an average cycle time of 43 minutes,[28] and including hourly service on Saturdays, the route would cost $173,500 per year to operate.

Table 6-4
Route C Weekday Ridership Projections
(w/Route C as a Local Route with All Day Service)

	Weekday Trips
New Local Trips	70
Ex-Rt 53/54 Trips	135
Trips to/fr Boston via Rt 304	135
Total:	**340**

With Route C operating as a variation of Route 300, ridership and costs would be lower since service would be provided only during peak periods. At 60 minute headways with four round trips provided in both the morning and afternoon, ridership would be 225 trips per day, with an operating cost of $112,800.

Relocation of Inner Terminal to Watertown Square/Through-Routing of All Trips to Boston

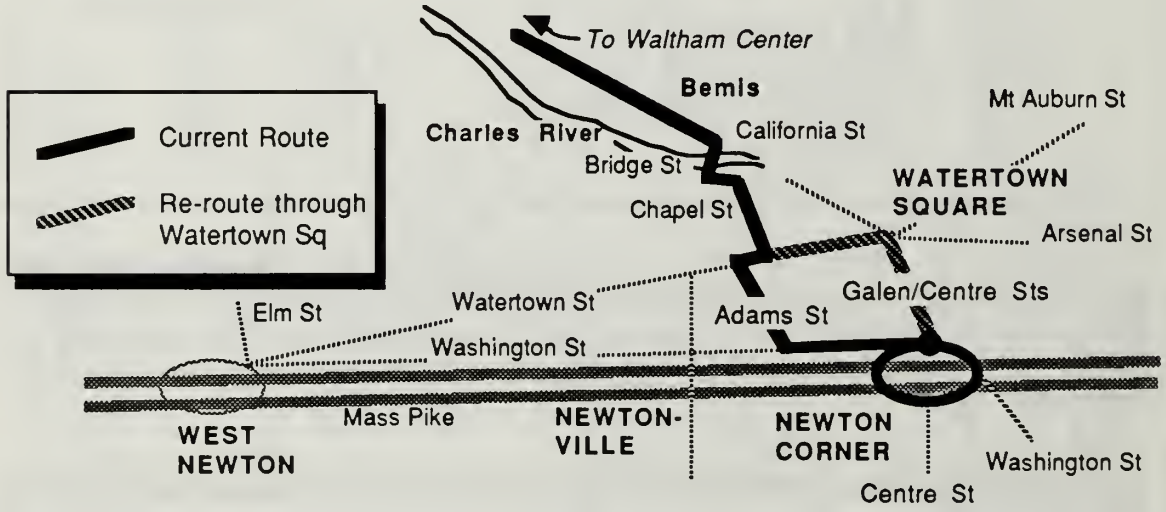
Along the inner end of the route, access to Boston could be improved by through-routing all Route 58 trips with Route 304. At present, although only seven peak period trips are through-routed with Route 304.1, 32 percent (125 transfers) of all Route 56 riders transfer to and from Route 304. Most of these are on the seven through-routed trips (75), but a relatively high percentage of riders on the other trips also transfer (21 percent, or 50 trips). Since the

[28]The total cycle time of trips through-routed with Route 304.1 would be 90 minutes.

percentage of transferring riders is already high, the through-routing of all trips would probably not result in large ridership increases, but would eliminate a transfer for 50 existing riders.

To through-route all trips, Route 58's inner terminal would have to be relocated to Watertown Square, or some Route 304.0 trips would have to be shifted to Newton Corner as Route 304.1 trips (since all mid-day Route 304.1 trips are already through-routed with other routes). The relocation of Route 58's inner terminal could be done by re-routing the segment between Chapel Street and Newton Corner along Watertown Street to Watertown Square (see Figure 6-3). As long as all trips were through-routed with Route 304.0, Newton Corner would continue to be served. This re-routing would leave the segment between Watertown Street and Newton Corner unserved by Route 58, which is used for 100 trips per day. However, all but 20 would still be within one-quarter mile of the revised route at either Watertown Street or Newton Corner. This segment would also be within walking distance of Routes 53, 54, and 56.

Figure 6-3
Re-routing of Route 58's Inner Terminal



The re-routing through Watertown Square would also increase the number of local trips served. Based on the trip-making characteristics of other Route 56 and Route 58 area riders, service through Watertown Square would increase Route 58 local ridership by up to 50 trips per day. Including the loss of 20 trips on Adams Street, the net increase in local trips on Route 58 would be 30 trips per weekday.

The shifting of Route 304.0 trips from Watertown Square to Newton Corner would be more problematic. At present, during the mid-day, Route 304.0 trips alternate with Route 304.1 trips, both of which operate at 30 minute headways. To through-route all Route 58 trips would mean reducing headways from Watertown Square to 60 minutes during mid-day. Without other changes to service from Watertown Square, this would take service away from many more Route 304 riders than would be benefited on Route 58.

LEVEL OF SERVICE

Existing Service

At present, all Route 58 trips operate at well below capacity, with nearly all trips experiencing maximum loads of less than 20 riders. During the base and school periods, the route does not meet MBTA performance standards, but with service at 60 minute headways, service cannot be realistically cut back.

During the AM and PM peaks, service does meet MBTA standards, but ridership is still low. During the AM peak, three inbound trips have an average peak load of 16 riders, and in the PM peak, the average peak load for outbound trips is 22. At these levels, service could be cut back from 30 - 60 minute headways to 60 minute headways, but the trips that would be cut during both periods carry the heaviest loads. Only three one-way trips could be eliminated, so that the cost savings would be small ($17,500). Further, the reduction of the three trips would cost 17 hours of additional passenger wait time for each hour of vehicle time saved.

Alternative Service

If service were revised as discussed above to create Route C and to truncate Route 58 at Waltham Center, headways would be dictated to a large extent by the routes with which they were through-routed. With Route 58 through-routed with Route A, and Route C designed to alternate trips with Route A on Washington Street, headways would need to be set at 30 or 60 minutes. Based on ridership projections, 60 minute headways would be sufficient on a shortened Route 58 and C during all periods.[29] This would also allow Route A and the shortened Route 58 to be coordinated with Route B (Brandeis/Roberts - Watertown Square via Waverley).

With 30 minute headways on Route A during peak periods, and 60 minute headways during off peak periods and throughout the day on a shortened

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[29]Based on estimated 90 minute cycle times for through-routed service, 45 minute headways could be provided with the same number of vehicles, but would not allow schedules to be coordinated.

Route 58 and Route C, a total of 112 one-way trips would be provided per day (see Table 6-5). This would be an increase of 30 percent, or 26 trips per weekday, over the current total of 86 on Routes 53, 54 and 58. Further, if all trips on the new routes were through-routed to Boston, as would be possible, the number of trips providing direct service could be increased from 59 to 112. This increase in service would increase operating costs by $66,700 per year, or 9 percent higher than the current operating costs for Routes 53, 54 and 58. The increase in operating costs would be lower than the increase in the number of one-way trips provided because most trips would be shorter due to the elimination of duplicative service. In terms of vehicle miles and hours, vehicle miles would decrease by seven percent, while vehicle hours would

Table 6-5
Operating Costs and Service Statistics

	Trips/ Day	Vehicle Miles	Vehicle Hours	Annual[30] Operating Cost ($000)	Vehicle Req'mt
Current Service					
Route 53	30	229.5	19.8	$261.4	2
Route 54	28	238.0	18.4	$254.4	2
Route 58	28	187.6	14.0	$192.4	2
	86	655.1	52.2	$708.2	6
Alternative Service[31]					
Route A	34	168.3	17.0	$212.3	2
Route B	26	230.1	19.5	$266.8	2
Route C	26	119.6	13.0	$166.8	1
Short Route 58	26	92.3	13.0	$129.0	1
	112	610.3	62.5	$774.9	6
Change	+26	-44.8	+10.3	+$66.7	0

increase by 20 percent.[32] Total AM peak vehicle requirements would remain unchanged.

[30]For current service, annual operating costs include the actual cost of Saturday service. Costs for alternative services assume hourly Saturday service.

[31]Statistics for alternative services based on following: Route A: 60 minute cycle time and round trip mileage of 9.9 miles; Route B: 90 minute cycle time and round trip mileage of 17.7 miles; Route C: 60 minute cycle time and round trip mileage of 9.2 miles; Shortened Route 58: 60 minute cycle time and round trip route mileage of 7.1 miles.

[32]The increase in service hours is largely due to less efficient scheduling assumed in these costs. While most of the (continued next page)

As previously mentioned, the major purpose of Route C would be to provide replacement service to current Route 58 riders that would be left unserved between Auburndale and Route 128 if Route 58 service beyond Waltham Center were terminated. Without Route C, from 65 to 115 trips (depending on how connections in Waltham Center were configured) would be left unserved or lost. However, operating costs for the alternative services could be reduced by $166,800 per year, or $100,100 lower than the cost of existing service on Routes 53, 54 and 58. AM peak vehicle requirements would also be reduced by one vehicle.

RELIABILITY

Route 58 currently operates with a 60 minute cycle time that allows very little recovery time between trips. With actual running times averaging 28 minutes in the inbound direction and 27 minutes in the outbound, only two to three minutes recovery time is scheduled at each end. Based on the observed running time variability,[33] six to seven minutes of recovery time would be needed at each end to insure at least 90 percent on-time departure performance for all trips, or eight minutes more than is currently provided. However, in spite of the apparent lack of sufficient recovery time, Route 58 did meet the MBTA 90 percent on-time departure standard when surveyed.

At present headways and current schedules, one bus is deployed to provide 60 minute headways. To provide additional recovery time would require one additional bus, longer headways, or the through-routing or inter-lining with another route that has excess recovery time. Since lateness is not currently a problem, one additional bus or longer headways would not be warranted. However, as development continues to occur in Waltham and Newton, and traffic worsens, reliability on Route 58 will likely become a problem. To avoid potential future problems, and if Route 58 continues to operate in its present form, it should be through-routed or interlined with another route to provide additional recovery time.

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alternative routes could operate at a 45 minute cycle time, a 60 minute cycle time was used based upon the assumed headways. With the through-routing of these trips to Boston, schedules could be made more efficient, which would reduce both the number of service hours attributed to the local service and resulting costs.

[33]Standard deviation of running times: inbound - 4.3 minutes; outbound - 4.4 minutes)

7. Route 59

Route 59.0 Needham Junction - Watertown Square
Route 59.1 Newton Industrial Park - Watertown Square

ROUTE PROFILE

There are two variations of Route 59. The major variation, 59.0, operates between Needham Junction and Watertown Square. Variation 59.1 (Route 59A) provides service between the New England Industrial Park, on the Newton/Needham Line off of Chestnut Street, and Watertown Square. Both variations operate along a common alignment between Newton Highlands and Watertown Square (see Figure 9-1). Service is provided throughout the day on Route 59.0, but only between 9:10 AM and 6:30 PM on Route 59A. As a result of the lack of AM peak service, Route 59.1 cannot be used by those commuting during normal work hours. However, on the trunk portion of the route, combined headways of from 10 to 35 minutes throughout most of the day result in the highest level of service of any of the WESTBus local routes. On both variations, connections can be made with the Green Line at Newton Highlands, and with commuter rail at Newtonville. On Route 59.0, connections can also be made with commuter rail at Needham Heights, Needham Center and Needham Junction.

Total ridership on Route 59 is 1,170 trips per day, with 970 trips on Variation 59.0, but only 200 trips per day on Variation 59.1 where no AM peak service is provided. As shown in Table 16, both variations are below the normal MBTA boardings per vehicle mile standard of 3.0 during at least one period, and Variation 59.1 is well below the boardings per vehicle hour standard of 30.0. However, since 86 percent
of Route 59's riders do not have a car, the route qualifies for lower standards of 1.0 boarding per vehicle mile and 20 boardings per vehicle hour. On this basis, both variations
meet the vehicle mile standard, but Route 59.1 still fails to meet the vehicle hour standard.

Most Route 59 riders are residents of Newton (54 percent), or Needham (16 percent), and make trips to Boston, Needham or Newton. Most ridership on

Figure 7-1

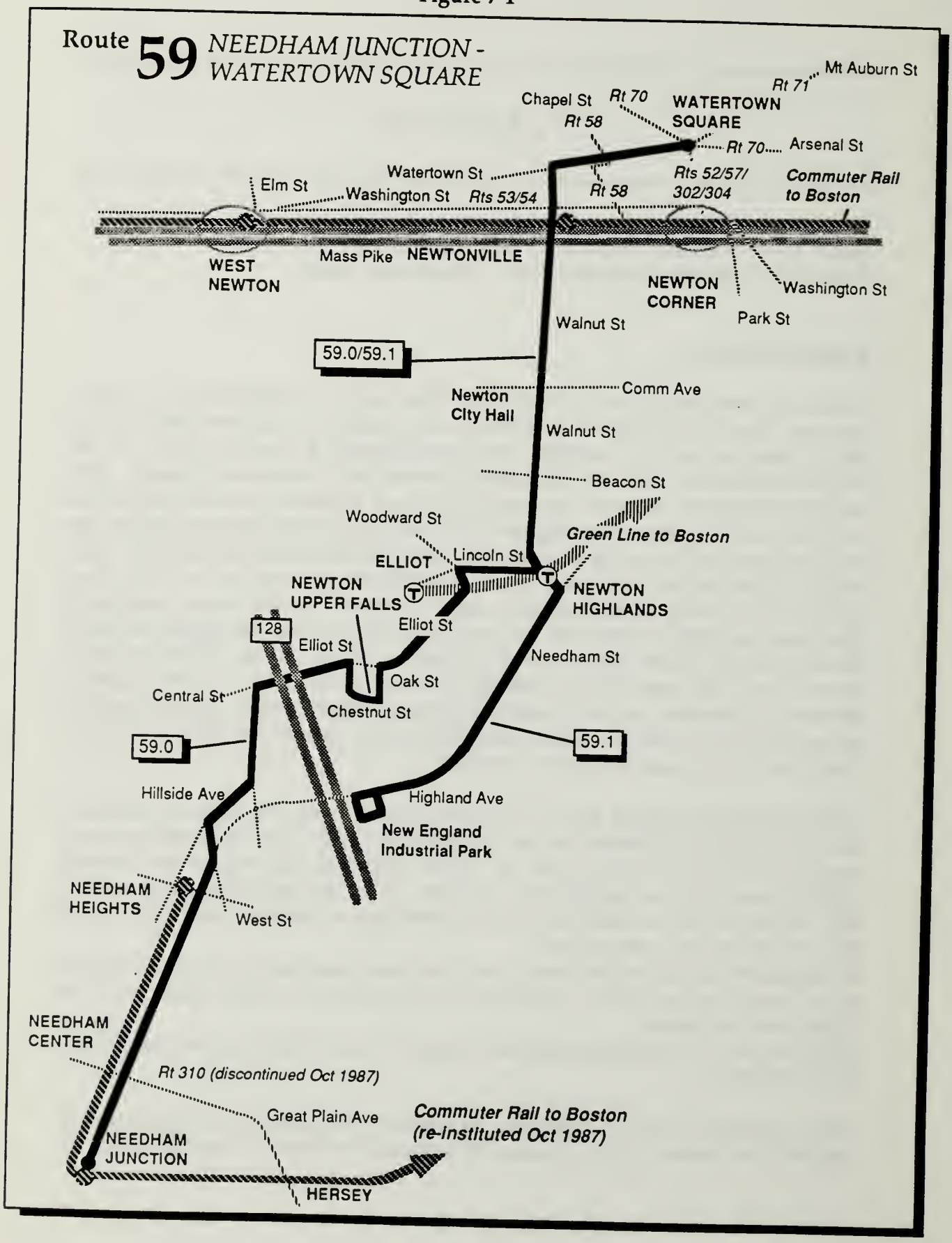
Route 59 NEEDHAM JUNCTION - WATERTOWN SQUARE
Mt Auburn St
Rt 71
Chapel St
Rt 70
WATERTOWN SQUARE
Rt 58
Rt 70
Arsenal St
Watertown St
Rts 52/57/ 302/304
Commuter Rail to Boston
Elm St
Washington St
Rts 53/54
Rt 58
WEST NEWTON
Mass Pike
NEWTONVILLE
NEWTON CORNER
Washington St
Park St
Walnut St
59.0/59.1
Comm Ave
Newton City Hall
Walnut St
Beacon St
Woodward St
Green Line to Boston
ELLIOT
Lincoln St
NEWTON UPPER FALLS
NEWTON HIGHLANDS
128
Elliot St
Elliot St
Needham St
Central St
Oak St
Chestnut St
59.0
59.1
Hillside Ave
Highland Ave
New England Industrial Park
NEEDHAM HEIGHTS
West St
NEEDHAM CENTER
Rt 310 (discontinued Oct 1987)
Great Plain Ave
Commuter Rail to Boston (re-instituted Oct 1987)
NEEDHAM JUNCTION
HERSEY

Table 7-1
Route 59 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:20AM - 6:35PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 59.0	9.0	38	30	60	28	30	–	342.0	27.7
Rt 59.1	5.8	20	–	60	56	58	–	116.0	10.5
Total:		**58**	**30**	**30**	**20**	**21**	–	**458.0**	**38.2**

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 59.0	969	3.8	2.1	2.9	2.6	35.0
Rt 59.1	201	–	1.4	2.3	2.2	19.1
Total:	**1170**	**3.8**	**1.8**	**2.7**	**2.5**	**30.7**

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 59All	$475,761	$135,799	$339,962	28.5%	$1.08

Other
Percent of passengers 65 or older: 10.8%
Percent without a car available for trip: 86.0%
Peak Load Points: Inbound: Walnut St. @ Prospect St. (near Comm Ave.)
Outbound: Walnut St. @ Commonwealth Ave.

Route 59.0 is in the inbound direction in the AM peak to Newton Highlands, Newtonville, and Watertown Square, and in the outbound direction in the afternoon from the same locations. However, there are also a significant number of trips in the reverse direction to and from the Green Line at Newton Highlands, and Needham Heights and Needham Center, accounting for up to 46 percent of peak period ridership. On Route 59.1, most late morning and early afternoon ridership is in the outbound direction to Newtonville, Newton Highlands, and a large number of widely scattered

destinations. PM peak travel patterns on Route 59.1 are similar to those on 59.0, except that there are very few ons at Newton Highlands in the outbound direction. Further, nearly all Route 59.1 ridership is on the trunk portion of the route; there is very little activity (only 45 trips) on the outer segment of the route between Route 9 and the New England Industrial Park.

Fifty-six percent of all Route 59 trips involve a transfer with another MBTA bus or the Green Line. All Green Line transfers (430 per day) are made at Newton Highlands, and most bus transfers (310 per day) occur in Watertown Square to Routes 52 (10 per day), 53 (15), 56 (10), 57 (65), 70 (100), 71 (60), 302 (20), and 304 (20). In addition to the Watertown Square transfers, 10 transfers per day are also made with Route 54 in Newtonville.

As indicated by the figures in Table 6, many Route 59 riders are transit dependent. Fourteen percent are under the age of 17, 11 percent are 65 or older, 86 percent do not have an automobile available, and 45 percent do not have a license. In addition, 56 percent have a household income of less than $20,000 per year.

SERVICE COVERAGE

Overall Assessment

Route 59 is similar to Route 52 in that the two routes are the only routes to provide service in a north-south direction through Newton. As with Route 52, Route 59 is long and serves a relatively small work trip market, but is the only route to provide service within its immediate service area. For both routes, the small market sizes are due, for the most part, to the lower density development in Newton and Needham compared to Waltham, which is served by the other WESTBus local routes.

Route 59 serves a direct work trip market[34] of approximately 1,670 trips per day. Although the route is the second longest of the WESTBus local routes (after Route 52), the market size is the third smallest, behind Routes 53, 54, and 58. Of the total work trip market, Route 59 carries 225 local work trips daily, for a transit mode split of 13 percent. This mode split is also similar to that of Route 52, and high for the WESTBus area.

The market for work trips to Boston is significantly larger, totaling 3,870 trips to and from the Financial District, Government Center, Back Bay and Park Square areas. In total, transit carries approximately 45 percent, or 1,920, of these trips. Most of the transit trips to Boston are made on Routes 302, 304, 310 and the Green Line, but 180 trips also involve a transfer with Route 59.

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[34]Work trips that begin and end within one-quarter mile of the route.

In terms of alignment, both variations of Route 59 operate in a fairly direct manner between the three terminals (Watertown Square, Needham Junction, and the New England Industrial Park). Service could be made more direct between Newton Highlands and Needham by routing all service along Needham Street to Highland Avenue, but the Route 59.0 alignment through Newton Upper Falls serves far more riders than does the Route 59.1 alignment along Needham Street (625 versus 200 during periods in which both variations operate). As a result, this basic alignment should be left unchanged.

Elimination of Route 59.1 Variation

The Route 59.1 variation, which has operated along Needham Street and Highland Avenue in Newton since 1984, was designed primarily to provide service from Newton Highlands to the shopping areas along Needham Street. The route does so in a direct manner but has failed to establish itself and is very poorly utilized. When observed, an average of only 45 trips per day used the 2.1 mile long segment beyond the Newton Highlands Station, with most of those trips to and from the Marshalls Department Store on Needham Street. The large majority of all Route 59.1 riders (155 of 200) use only the trunk portion of the route between Watertown Square and Newton Highlands, and could be served equally well by Route 59.0, which has excess capacity. As a result, considering the sub-standard performance of Route 59.1, and that most Route 59.1 trips could be carried by Route 59.0, the Route 59.1 variation should be eliminated. This would save $331,500 per year in operating costs.

Improved Connections to Boston

On Route 59.0, other than riders that would shift from Route 59.1 if that service were eliminated, significant increases from within the local market are not likely. As mentioned above, the market is small, and ridership is too low to justify shorter headways. Instead, there would be greater opportunities to increase ridership from the Route 59 area to Boston. This could be done by through-routing service with Route 304.0 in Watertown Square, and by coordinating schedules with commuter rail service in Needham.

At the inner end of the line, if service were through-routed to Boston, the through-routing would have to occur at Watertown Square with Route 302 or Route 304.0. A re-routing of Route 59 directly from Newtonville to Newton Corner via Washington Street in order to combine Route 59 with Route 304.1 would not be feasible since it would leave 485 existing trips, or 42 percent of all Route 59 trips unserved. The through-routing of trips at Watertown, although adding five to eight minutes of travel time (compared to the direct

route via Washington Street), would be faster than most transfers and would provide a one seat ride to Boston.

Based on observed travel times to downtown Boston on the Green Line and Routes 59/302 and 59/304 from Newton Highlands, a through-routed Route 59 would be the faster option for most persons traveling to or from points beyond walking distance north of the Newton Highlands Green Line station. As a result, most travelers to Boston from this area would be better served by combined Routes 59/302 or 59/304, while riders within walking distance and south of Newton Highlands continue to be best served by their present mode. On this basis, the through-routing of Route 59 with Route 302 would attract up to 65 new riders to Route 59, plus eliminate a transfer for 20 existing riders. With Route 304.0, through-routing would attract up to 150 additional trips per day, as well as eliminate a transfer for 20 existing riders. Of the 150 new trips, approximately 60 would be made by new transit riders, and up to 90 would be made by those that now drive to the vicinity of Newton Corner and Watertown Square to use Route 304.

Coordination with Commuter Rail Service

At the Needham Junction end of Route 59.0, the route is affected by the re-institution of commuter rail service that occurred on October 19, 1987. (At the same time, express service to Boston from Needham on Route 310 was discontinued.) During peak periods, commuter rail operates to Needham Heights, but during the mid-day (10:35 AM to 3:35 PM), service operates only to Needham Junction (see Figure 7-2). As a result, so that trips to and from Needham Heights would be possible during all periods, Route 59's schedule should be coordinated with commuter rail during the mid-day.

During the mid-day, commuter rail service operates at one to two hour headways (see Table 7-2), with trains laying over in Needham Junction for 20 minutes. With this amount of layover time, it would be possible to coordinate schedules closely in only one direction, or to require approximately ten minutes of wait time for both inbound and outbound transfers. The advisability of either would be dependent on travel patterns to and from commuter rail and whether or not Route 59 were through-routed with Route 304.

If Route 59 is not through-routed with Route 304 and commuter rail ridership is highly directional during the mid-day (such as inbound during the morning and outbound in the afternoon), Route 59 trips should be scheduled to provide better connections to the more highly traveled direction. This would require that the afternoon schedule shift by approximately ten minutes when the change in ridership direction occurs.

Figure 7-2
Connections between Route 59 and Commuter Rail

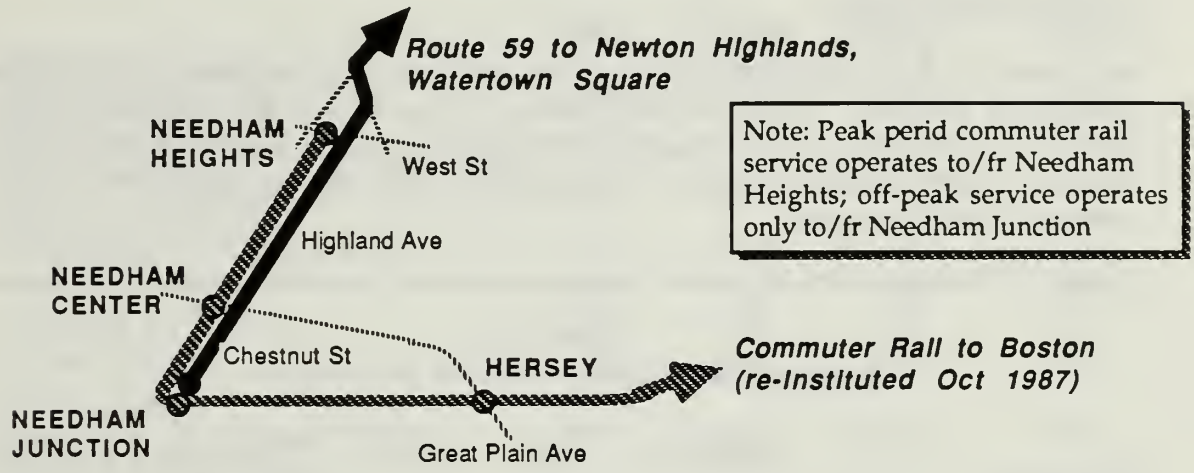

Table 7-2
Arrival and Departure Times of Commuter Rail Trips
Terminating or Originating at Needham Junction (Fall 1987)

	Needham Junction	
Train Number	Arrive	Depart
6235/6238	10:35 AM	10:55 AM
6243/6248	12:35 PM	12:55 PM
6251/6254	2:35 PM	2:55 PM
6255/6258	3:35 PM	3:55 PM

If Route 59.0 is through-routed with Route 304, due to the inter-relationships between Routes 304.0, 304.1, and local routes, the schedule shift could become too disruptive to those other routes. In this case, wait times of approximately 10 minutes would be required. However, the inconvenience of the wait time could be mitigated somewhat if passengers were allowed to board the bus during the layover period, as is done on commuter rail, instead of requiring them to wait outside of the bus until only shortly before departure time.

During peak periods, Route 59 operates at 30 minute headways, while commuter rail operates at irregular headways of 35 to 45 minutes. As a result of the non-matching headways, it would not be possible to coordinate more than one trip during each peak. However, while coordination of the two

services would be preferable, the lack of coordination should have little impact on ridership since peak period trains operate to Needham Heights.

LEVEL OF SERVICE

As shown in Table 7-3, there is excess capacity on both variations of Route 59 during all periods. With the elimination of Route 59.1 as discussed in the previous section, most of its riders (155 of 200) would be served by Route 59.0 instead. These riders could be easily accommodated by Route 59.0 at the current level of service.

Table 7-3
Average Peak Loads on Routes 59.0 and 59.1

	AM Peak	Base	School	PM Peak	Evening
Route 59.0					
Inbound	23	11	13	15	--
Outbound	16	12	19	14	17
Route 59.1					
Inbound	--	3	15	7	4
Outbound	--	9	9	11	--

The elimination of service on Route 59.1 would effectively increase headways on the trunk portion of Route 59 between Watertown Square and Newton Highlands. During the base period, headways would increase from an average of 30 minutes to 60 minutes; during the school peak, headways would increase from 20 to 28 minutes; and in the PM peak, the increase would be from 21 to 30 minutes. This increase in headways would result in a decrease in ridership on Route 59.0 and in the number of riders that would shift from Route 59.1 (a total of 135 per day). However, as shown in Table 7-4, the loss in ridership would be relatively small in relation to the MBTA resources involved. A total of 10.5 vehicle hours and one vehicle would be saved daily, resulting in an operating cost savings of $331,500 per year. The increase in wait time for those using service between Watertown Square and Newton Highlands would also be relatively small. For those passengers continuing to ride Route 59, total wait time would be increased by 48.6 hours per day, or only 4.6 hours for each hour of vehicle time saved.

Table 7-4
Impacts of the Elimination of Route 59.1

	Base	School	PM Peak	All Day
Impact on Resources				
•Vehicle Hours Saved	5.0	2.0	2.9	10.5
•Vehicles Saved	1	1	1	1
•Operating Cost Savings: $331,500 per year				
Impact on Ridership				
•Passengers Left Unserved	-15	-10	-20	-45
•Longer Headways[35]	-45	-20	-25	-90
•Increase on Rt 59.0	25	20	20	65
•Total Change	-60	-30	-45	-135
Other Impacts				
•Add'l Pax Wait Time (hrs)[36]	29.8	8.4	10.4	48.6
•Add'l Pax Wait Time/ Vehicle Hours Saved	6.0	8.4	3.6	4.6

RELIABILITY

When ridechecked, Route 59 experienced lateness problems in both directions. In total, 28 percent of all trips, including seven of 28 inbound trips and nine of 30 outbound trips, were observed to depart three or more minutes late. Although data was not available on Route 310, it appears that late departures were caused by late arrivals on both Routes 302 and 310, with which Route 59 was extensively inter-lined prior to the discontinuation of Route 310. Schedule problems were not the result of problems on Route 59 itself. Route 59 running times averaged two to three minutes shorter than scheduled (35 versus 38 minutes inbound; 35 versus 37 minutes outbound), and no consistent major problems along the route were apparent.

[35]Includes loss on Route 59.0.
[36]Continuing riders only.

8. Route 300

Route 300 Riverside - Downtown Boston

ROUTE PROFILE

Route 300 provides express service between the Riverside Green Line station and downtown Boston (see Figure 8-1). It operates as both an alternative and a supplement to Green Line service during peak periods at four to 30 minute headways. A summary of ridership and operating statistics are shown in Table 8-1.

In terms of boardings per vehicle mile, Route 300 does not meet MBTA standards during any time period. However, low performance in this area is due to fairly unique characteristics of the route, and not low ridership.

The route is the longest in the WESTBus corridor, but because of its express nature and routing, there is only the one stop outside of downtown Boston (at Riverside). As a result, although most peak direction trips are close to, at, or exceed seated capacity, no additional passengers are picked up along the route, so that passengers per vehicle mile figures are low. However, since speeds on the Massachusetts Turnpike are high, passengers per vehicle hour figures are well above MBTA standards.

Whereas on other WESTBus routes, most riders walk to and from the bus at the outer end of the line, most Route 300 riders either drive and park in the Riverside lot (77 percent) or are dropped off (7 percent). In addition, because of the availability of parking at Riverside and the short travel time to downtown Boston, the route serves an area much larger than most bus routes. The riders, most of whom do not live near the line, are from Newton (22 percent), Wellesley (18 percent), Weston (12 percent), and other towns (48 percent), mostly beyond Route 128. Nearly all trips are to Boston (98 percent), and although rail service is available at Riverside on the Green Line, ten percent of Route 300's riders (accounting for 160 trips per day) use the route to travel to downtown and then transfer to the rail transit system. In addition, inbound ridership is higher than outbound ridership by almost 37 percent

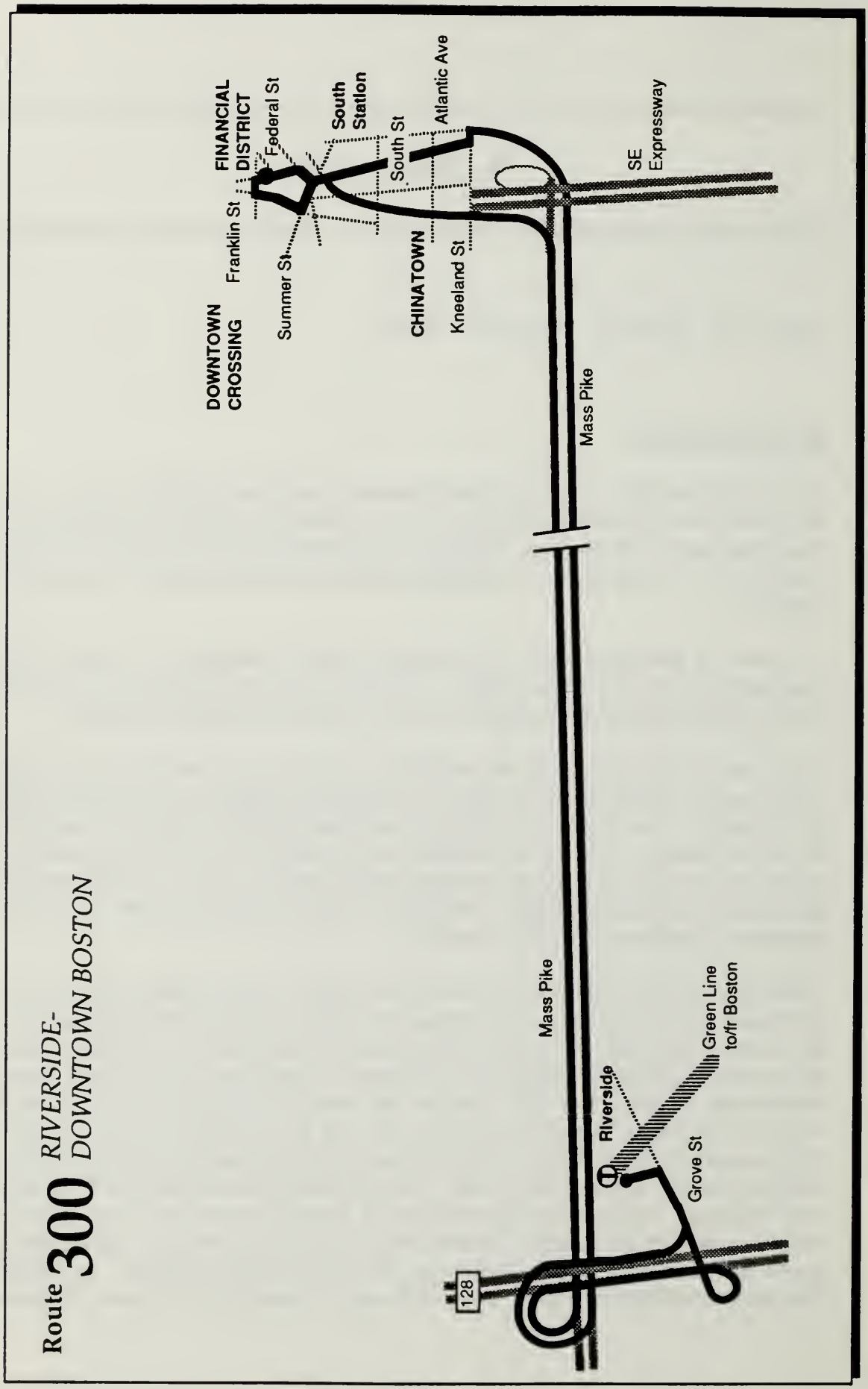
Route 300 RIVERSIDE-DOWNTOWN BOSTON
DOWNTOWN CROSSING
FINANCIAL DISTRICT
CHINATOWN
Franklin St
Federal St
Summer St
South Station
South St
Atlantic Ave
Kneeland St
SE Expressway
Mass Pike
Mass Pike
Riverside
Green Line to/fr Boston
Grove St
128

Figure 8-1

Table 8-1
Route 300 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:45AM - 9:15AM and 2:30 PM - 7:00 PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 300	6.7	72	8	4T[37]	2T	8	–	979.2	34.8

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 300	1,610	2.1	1.9	0.9	1.4	46.3

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 300	$542,500	$483,000	$59,500	89.0%	$0.15

Other
Percent of passengers 65 or older: 1.5%
Percent without a car available for trip: 16.3%
Peak Load Points: Inbound: Riverside
Outbound: Surface Artery at Kneeland

(930 versus 680). This difference is due to the lower outbound fare on the Green Line, which encourages many riders who use Route 300 in the morning to use the Green Line in the afternoon.

Nearly all Route 300 trips are for work purposes (93 percent), and, as would be expected, there is a very low level of transit dependency on the route. Only three percent of all riders are 17 or under, less than two percent are 65 or older, 84 percent have a car available, and 72 percent have a household income of more than $40,000 per year.

[37]T=trips

SERVICE COVERAGE

Overall Assessment

With Route 300's only official stop[38] outside of downtown Boston located at Riverside, only 11 percent of the route's riders walk to and from the route at the outer end. Instead, most riders drive to or are dropped off at the route (84 percent). Most of these riders come from outside of the WESTBus area (69 percent) or from Newton (22 percent). Of those coming from outside of the WESTBus area, most are from Wellesley (18 percent of all riders) and Weston (12 percent). Similarly, by the nature of the route, the destinations of Route 300's riders are also outside of the WESTBus area, in Downtown Boston. The most popular destinations are the Financial District/ Government Center (66 percent) and the Back Bay/Park Square areas (seven percent).

Based on these characteristics, two areas from which new transit ridership could be attracted, or service made more convenient to existing riders, would be as follows:

- Improved direct access to Route 300 at the outer end.
- Expanded service coverage in Boston to Copley Square, Park Square and/or Beacon Hill.

Improved access at the outer end of the route would require variations of Route 300 that would increase service coverage near the outer end of the route. Expanded service in Boston could take the form of variations of Route 300, or the implementation of a new route from Riverside. As further discussed below, all of these approaches would result in some ridership increases and/or more convenient service for existing riders, but all would also be extremely costly in terms of the benefits received.

Route Variations to Provide Increased Access Along Outer End of Route

Along the outer end of Route 300, two variations could expand service coverage while still providing direct service. Both would operate parallel to the Mass Pike on Commonwealth Avenue, Lexington Street, Auburndale Street and Elm Street to West Newton. At West Newton, the first variation, Route "300.1" would enter the Mass Pike to Boston. The second variation, "Route 300.2," would continue from West Newton along Washington Street to Newton Corner to the Mass Pike (see Figure 8-2). One-way travel times via

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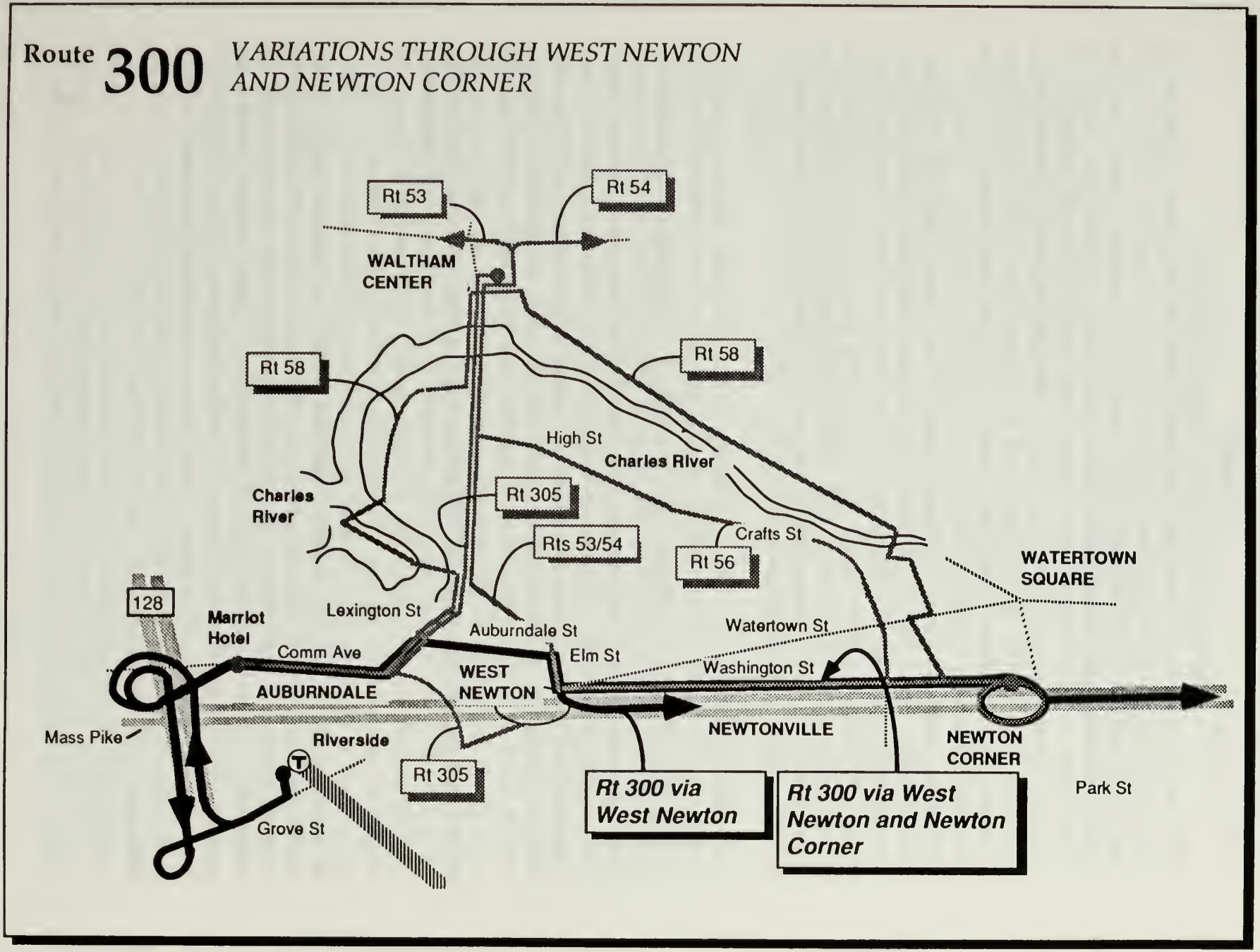
[38]Some drivers will pick up or drop off passengers on Grove Street near Route 128.

Figure 8-2


Route 300 VARIATIONS THROUGH WEST NEWTON AND NEWTON CORNER
Rt 53
Rt 54
WALTHAM CENTER
Rt 58
Rt 58
High St
Charles River
Charles River
Rt 305
Rts 53/54
Crafts St
Rt 56
WATERTOWN SQUARE
128
Marriot Hotel
Lexington St
Auburndale St
Watertown St
Comm Ave
Elm St
Washington St
WEST NEWTON
AUBURNDALE
NEWTONVILLE
NEWTON CORNER
Mass Pike
Riverside
Rt 305
Park St
Grove St
Rt 300 via West Newton
Rt 300 via West Newton and Newton Corner

West Newton would be five to six minutes longer than for Route 300, while via West Newton and Newton Corner, they would be approximately 13 minutes longer.

With additional local coverage between Riverside and West Newton or Newton Corner, three distinct markets would be served. First, both variations would provide more direct service for current riders that live north of the Mass Pike in Newton that now drive to Riverside. Many of these riders would change their access mode from driving to Riverside to walking directly to the route. In addition, of riders that would shift, those that now ride Route 300 inbound and the Green Line outbound (to take advantage of the fare differential) would then also ride Route 300 in the outbound direction. Second, with more local service, Route 300 variations would also provide transit access to the Green Line from Waltham and Newton. This type of service does not now exist, and would improve connections between Waltham and North Newton and suburban areas served by the Green Line. Lastly, these variations would provide local service along Commonwealth Avenue and Washington Streets, which could allow service levels on local Routes 53, 54 and/or 58 to be reduced without leaving existing riders of those routes unserved.

In terms of ridership, both variations would provide more convenient service to a significant number of existing riders, but only 35 or fewer new transit trips would be attracted (see Table 8-2). For the most part, increases in new transit ridership would be low because the variations would serve areas that are already fairly well served. To Boston, service is now provided from Auburndale on Route 305, and, from the area between West Newton and Newton Corner, on a number of through-routed trips on Routes 53, 54, and 56 . In addition, many of the area's residents drive to Newton Corner to access Route 304. As a result of these services, the transit mode split to Boston is already high (up to 81 percent around Auburndale), and no further significant increases would be expected. Lastly, although improved access would be provided to the Green Line from north of the Mass Pike, the market for this service is very small, and in many cases, better served by Routes 52 and 59.

Due to the small number of new trips that would be attracted, appropriate headways would be 30 minutes or longer unless regular Route 300 riders were forced onto the variations. However, either measure would result in ridership losses that would offset other gains. Thirty minute headways would reduce the ridership figures for the two variations shown in Table 8-2 by about 23 percent, while longer travel times on the variations would result in the loss of seven to 13 percent of the current Route 300 riders that would be affected.

Table 8-2
Ridership Impacts of Route 300 Variations
(One-way Trips)

	Route 300.1 (via W.Newton)	Route 300.2 (via Newton Cnr)
1. *Existing Riverside Riders*		
•Change in Access Mode from Drive to Walk	160	175
•Shift fr Green Line to Rt 300	25	30
•Subtotal	185	205
2. *New Ridership*		
•New Trips to Boston	0	0
•New Local Trips	0	35
•Subtotal	0	35
3. *Substitute Service for Local Routes*		
•Outer Segment of Route 58	30	30
•Routes 53/54 along Washington St	0	45
•Subtotal	30	75
4. Total Increase	**215**	**315**

Lastly, due to the peak period nature of Route 300, the two variations could carry only about half of the local trips now made along the outer segment of Route 58 along Commonwealth Avenue. As a result, while either variation could provide some replacement service, neither could completely replace Route 53, 54 or 58 service.

Expanded Service Coverage in Boston to the Back Bay, Park Square and Beacon Hill

While bus service supplements Green Line service to downtown Boston, there is no comparable bus service to the Back Bay, Park Square or Beacon Hill areas. These areas are the work location of 32 percent of those that live in the WESTBus area and work in Boston, and also many that live beyond the WESTBus area. Due to the availability of parking at Riverside and good automobile access, direct service to the Back Bay, Park Square and/or Beacon Hill would be likely to attract riders from a wide area in the same manner as to the Financial District.

On an operational level, the feasibility of new service to these areas would be based upon local traffic conditions, and the availability of a suitable layover point. On this basis, three options would be most likely: (1) service to the Back Bay and Park Square, (2) service past Park Square to Federal and Franklin

Streets, and (3) service past Park Square and around Boston Common (see also Figure 8-3).

1. **Riverside to the Back Bay and Park Square.** This service would be the shortest of the three considered, and would operate from Riverside on the Mass Pike to Copley Square, and then to Park Square along Stuart Street. It would return to Copley Square along St. James Avenue. Since service would terminate at Park Square, it could not be operated as a variation of Route 300 and would require the implementation of a new route.

2. **Riverside to Downtown Boston via the Back Bay, Park Square.** Rather than terminating service at Park Square, service could continue on to Federal and Franklin Streets, which would allow it to operate as a variation of Route 300. The alignment between Copley Square and downtown Boston would be the same as that previously travelled by Route 310.

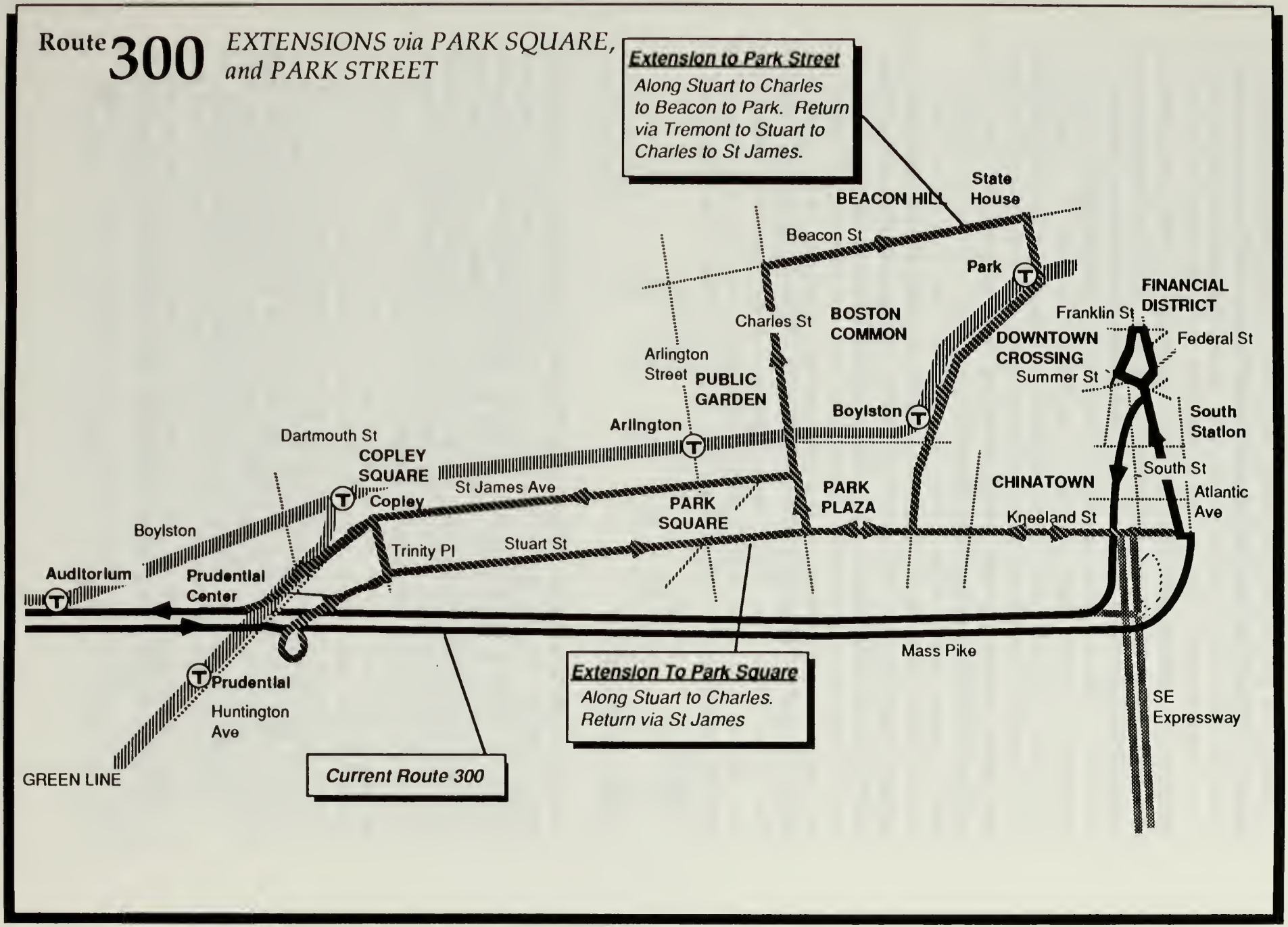
3. **Riverside to the Back Bay, Park Square and Beacon Hill.** This service would be similar to that to Park Square but would continue on past Park Square and around Boston Common on Charles Street and Beacon Street to a terminal at Park Street. The return via Copley Square would be along Tremont, Stuart and St. James Streets. As with the Park Street service, since the terminal would differ from that of Route 300, this service would also require the implementation of a new route.

At service levels comparable to those now provided on Route 300, these new services could increase bus ridership by 230 to 300 trips per day. However, based on these ridership levels, headways of only 30 minutes would be required. At these headways, ridership would be approximately 23 percent lower, as shown in Table 8-3.

Table 8-3
Summary of Ridership Impacts of Extensions of Route 300

	Park Square	Beacon Hill	Total	Increase
• Current Route 300	100	0	100	–
• Riverside-Park Square	280	0	280	**180**
• Riverside-Park Street	280	50	330	**230**
• Riverside-Downtown via Back Bay/Park Sq	280	0	280	**180**

Figure 8-3


Route 300 EXTENSIONS via PARK SQUARE, and PARK STREET
Extension to Park Street
Along Stuart to Charles to Beacon to Park. Return via Tremont to Stuart to Charles to St James.
BEACON HILL
State House
Beacon St
Park
FINANCIAL DISTRICT
Franklin St
Federal St
Charles St
BOSTON COMMON
DOWNTOWN CROSSING
Summer St
Arlington Street
PUBLIC GARDEN
Boylston
South Station
Arlington
Dartmouth St
COPLEY SQUARE
Copley
St James Ave
PARK SQUARE
PARK PLAZA
CHINATOWN
South St
Atlantic Ave
Kneeland St
Boylston
Trinity Pl
Stuart St
Auditorium
Prudential Center
Mass Pike
Prudential
Huntington Ave
SE Expressway
GREEN LINE
Extension To Park Square
Along Stuart to Charles. Return via St James
Current Route 300

Ridership on the variation of Route 300 operating to downtown Boston but through the Back Bay and Park Square would be expected to carry essentially the same ridership as service only to Park Square. Due to the longer running time (approximately five to six minutes in each direction), it would be difficult to replace existing Route 300 trips with these trips without inconveniencing existing passengers. As a result, it would be necessary to add new trips that could not be easily integrated with existing Route 300 schedules. Without coordinated schedules, the service increase would not be apparent to most riders, so that a significant increase in ridership to downtown Boston would not be expected. Further, the extension beyond Park Square to Federal and Franklin Streets would not also provide service to any others areas that would not be served by the combination of new service only to Park Square and existing Route 300.

As with most new transit services, many of the riders of the new services would be those that shifted from other existing services. For these alternatives, the shift would occur from the Green Line. Although data is not available to estimate to what degree this shift would occur, it would be affected by the headways on the new service. Currently, Route 300 is an attractive alternative to the Green Line because its service levels are similar to that of the Green Line. With longer headways to the Back Bay, Park Square and Beacon Hill, it is likely that the shift from the Green Line would be smaller, which could reduce ridership to levels below those presented in Table 8-3.

LEVEL OF SERVICE

Route 300 operates at four to ten minute headways during peak periods in the peak direction. At the time ridechecks were performed, crowding was not a problem, with an average of four standees per AM peak inbound trip, and usually none in the PM peak. However, in the AM peak, due to passenger reluctance to board buses on this route without a seat available, some service adjustments are needed. In the PM peak, there is an oversupply of service, and up to three trips could be eliminated.

AM Peak

When ridechecks were conducted, most buses deployed on Route 300 were older MBTA buses with a seating capacity of from 43 to 51. Since that time, more of the newer RTS II buses with a seating capacity of 40 are being used, thus increasing standing loads. With the use of all RTS II buses, the number of trips with standees in the AM peak would increase by four, and the average number of standees would increase from four to seven. Further, during this period, passengers were observed choosing not to

board buses with all seats already taken, and instead waiting to for the next trip in order to get a seat.

Based on MBTA standards, passengers should not be made to stand for more than 10 minutes, which is the case for all standees on Route 300. To eliminate standees in the AM peak would require three additional trips at a cost of $42,200 per year.

PM Peak

In the PM peak direction, loads are significantly lower than for the AM peak direction (see Table 8-4), and nearly all trips operate below capacity. This is most likely due to MBTA fare policy, under which outbound Green Line service from Boston is 60 cents, versus $1.50 on Route 300. For up to 27 percent of Route 300's inbound riders, the lower Green Line fare outweighs the shorter travel time and the availability of a seat on Route 300.

Table 8-4
Route 300 Peak Loads

	AM Peak		Base		School		PM Peak	
	In	Out	In	Out	In	Out	In	Out
Period Average	47	4	35	--	2	15	2	29
Peak Half-Hour	49							38

Before 4:40 PM, peak loads average only 24 passengers with 10 minute headways. These headways could be increased to 15 minutes while still providing all passengers with a seat, or to 20 minutes with an average of two standees per trip. At 15 minute headways, two vehicle trips and up to two hours of vehicle time would be saved. The longer headways would result in a loss of about 20 of 110 existing riders, at a cost of 3.9 hours of additional wait time for the remaining riders, or two hours of passenger wait time for each hour of vehicle time saved. Peak loads would average 31. An increase to twenty minute headways would save three trips and up to three vehicle hours at a cost of 30 passenger trips and 6.9 hours of additional passenger wait time (3.5 hours of passenger wait time for each hour of vehicle time saved). Peak loads with 20 minute headways would average 42, slightly higher than the seated capacity of the RTS II buses.

While 20 minute headways would be more appropriate on the basis of passenger loads, they would also be over two and one-half times longer than AM peak headways, and twice as long as existing 10 minute headways. This large of a discrepancy between AM peak and PM peak

headways could offset the benefits of short AM peak headways, and result in more broad based ridership losses than have been captured in the above estimates. In this case, fifteen minute headways would provide a better balance between PM peak passenger volumes and AM peak service levels.

Between 4:40 PM and 5:30 PM, headways could be increased from an average of 5.8 minutes to 7.5 minutes. With this increase, one trip and one hour of vehicle time could be saved, at a cost of 10 passenger trips, and only 2.9 hours of additional wait time. Peak loads during this time would increase from 31 to 36. The reduction of two trips would increase average loads to 44, which would still provide most passengers with a seat, but also result in extremely crowded loads on some trips (in excess of 60 passengers).

After 5:30 PM, service now returns to 10 minute headways, with five trips operated through the end of the period. Five trips continue to be needed, but the first two trips are much more heavily utilized than the last three (up to 50 passenger trips versus 20 to 30 trips). To better distribute these loads, 7.5 minute headways, if adopted, should continue until 5:45 PM, and then 15 minute headways until the end of service.

RELIABILITY

On Route 300, 33 percent of all trips were observed to depart three or more minutes late (see Table 8-5). Most of the late departures were caused by late arrivals on the incoming trips, which in turn were caused by running times that now significantly exceed scheduled book times. In addition, a number of late departures were also observed on the first trip out of the garage, either resulting from delays there, or between the garage and the beginning of the first trip.

By period and direction, average running times are now up to six minutes longer than book times (see Table 8-6). On specific trips, due to traffic problems, running times can be as long as 34 minutes, compared to maximum book times of 26 minutes. The result of these longer running times is that many trips arrive at the end of the route late, and the scheduled recovery time is not sufficient to prevent lateness from being carried over to the next trip. As also shown in Table 8-6, while an average of seven to 11 minutes of recovery time is scheduled for each round trip during peak periods, due to longer running times, only two to six minutes are actually available. To insure that at least 90 percent of all trips leave at their scheduled departure time, and due to the variability of running times on the Mass Pike and in downtown Boston, 12 to 14 minutes should be provided.

Table 8-5
Route 300 On-Time Departure Performance

	> 2 Min Early	3-5 Min Late	> 5 Min Late	On-Time[39]	# Trips Observed
Inbound					
AM Peak	0%	41%	0%	59%	17
PM Peak	0%	9%	0%	91%	11
All Day	0%	29%	0%	71%	35
Outbound					
AM Peak	15%	16%	8%	61%	13
PM Peak	0%	12%	6%	82%	17
All Day	3%	19%	3%	75%	72
All Day/ Both Directions	3%	29%	4%	64%	72

Table 8-6
Route 300 Schedule Statistics
Scheduled Versus Observed

	7:00AM-8:59AM	9:00AM-3:59PM	4:00PM-5:59PM	6:00PM-6:59AM
Inbound				
Scheduled Run Time (min)	24	22	22	20
Observed Run Time (min)	27	25	25	19
STD of Obs Run Times (min)	2.8	2.5	4.6	0.0
Outbound				
Scheduled Run Time (min)	26	24	26	24
Observed Run Time (min)	26	30	28	24
STD of Obs Run Times (min)	5.5	0.0	4.8	4.0
Round Trip				
Scheduled Cycle Time (min)	57	57	59	57
Sched RT Run Time (min)	50	46	48	44
Obs RT Run Time (min)	53	55	53	43
Schd Cycle/Run Time	1.14	1.24	1.23	1.30
Obs Cycle/Run Time	1.08	1.04	1.11	1.33
Schd Recovery/Layover Time	7	11	11	13
Obs Recovery/Layover Time	4	2	6	14
STD * 1.5 (min)	12	4	14	6

[39]The definition of "on-time" used here is 0 to 2 minutes late, as opposed to the MBTA definition of 0 to 5 minutes late.

To provide additional recovery and to accommodate longer running times, cycle times need to be lengthened. In addition, during the AM peak, longer inbound running times continue through the end of inbound service at 9:15 AM, while the current book times shift to a lower time at 9:00 AM.[40] Instead, the AM peak scheduling period should be extended through 9:15 AM.

The approximate changes needed in these respects are as shown in Table 8-7.[41] During both the AM and PM peaks, if existing headways are to be maintained, longer cycle times would require the deployment of an additional bus. If PM peak headways were to be revised as discussed above, vehicle savings would be reduced from two to one.

Table 8-7
Route 300 - Revised Schedule Statistics
to Alleviate Lateness Problems

	7:00AM-9:15AM	9:16AM-3:59PM	4:00PM-5:59PM	6:00PM 6:59AM
Inbound				
Average Run Time (min)	27	25	25	19
Outbound				
Average Run Time (min)	26	30	28	24
Round Trip				
Round Trip Run Time (min)	53	55	53	43
Recovery/Layover Time (@ STD * 1.5)(min)	9	4	14	6
Cycle Time (min)	62	59	67	49
Cycle/Run Time Ratio	1.17	1.07	1.26	1.14

[40]For more detailed information on running times and other schedule statistics, including trip by trip observations, see Technical Supplement 1.
[41]Actual cycle and recovery times would vary somewhat based upon actual scheduling.

9. Route 301

Route 301.0 AM	*Brighton Center - Downtown Boston inbound via Newton Corner; outbound via Union Square*
Route 301.0 PM	*Brighton Center - Downtown Boston inbound via Union Square; outbound via Newton Corner*
Route 301.1	*Brighton Center - Downtown Boston via Newton Corner*
Route 301.2	*Brighton Center - South Station via Union Square*

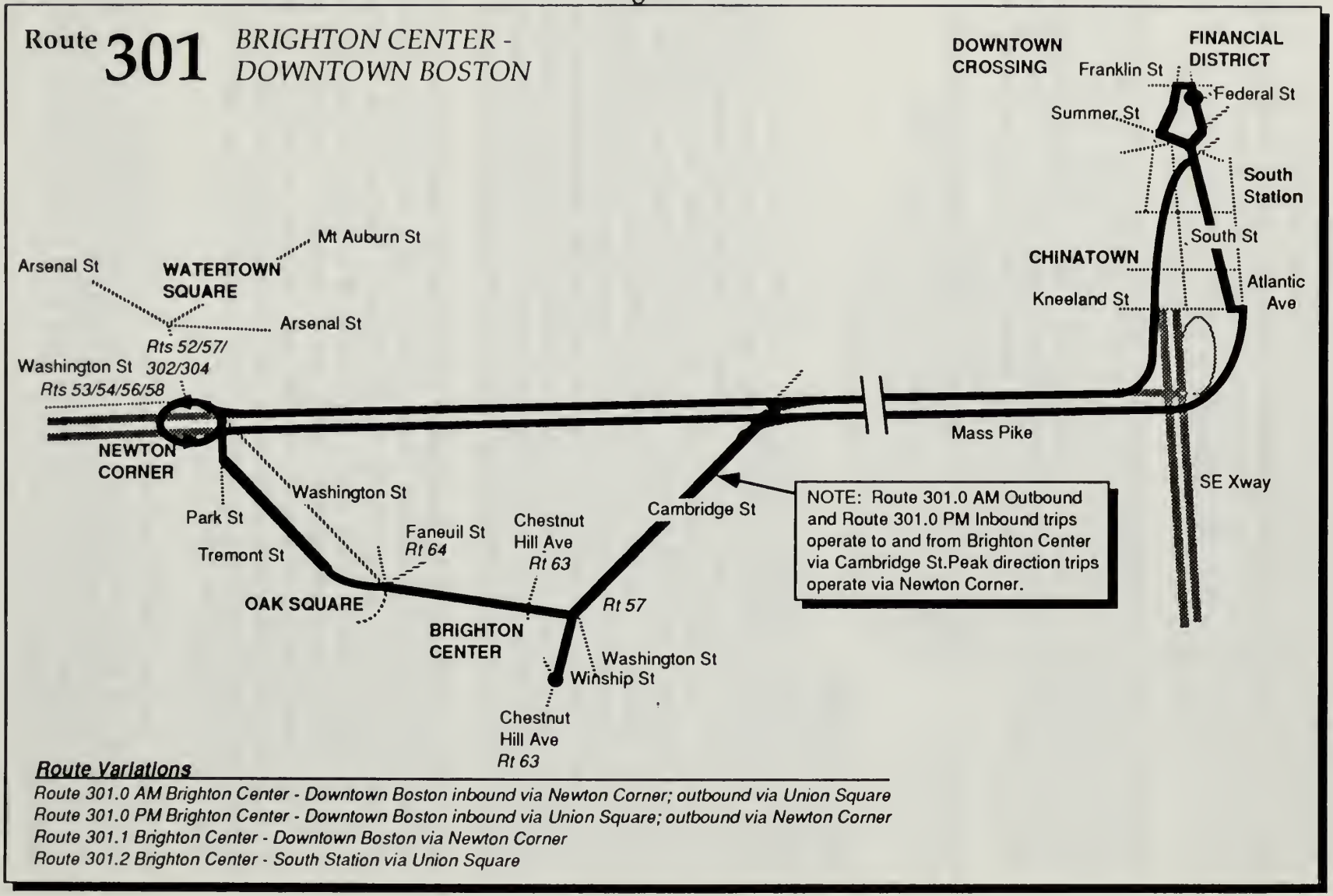
ROUTE PROFILE

Route 301 has three variations: 301.0, 301.1, and 301.2. Variations 301.0 and 301.1 both operate between Brighton Center and downtown Boston at Federal and Franklin Streets, but along different inbound alignments in the afternoon. Route 301.0 operates only during rush hours and operates via Newton Corner in the peak direction (AM inbound; PM outbound). In the non-peak direction, it travels via Cambridge Street (see Figure 9-1), which allows it to return to the opposite end of the route more quickly than by way of Newton Corner. Route 301.1 operates only in the afternoon and early evening, with all trips in both directions traveling to and from downtown Boston by way of Newton Corner. The third variation, Route 301.2, is a single school trip that operates inbound via Cambridge Street to South Station.

Ridership on Route 301 is approximately 2,220 trips per weekday, the second highest among WESTBus routes. Peak direction trips are heavily utilized, with most trips close to, at, or over seated capacity, but non-peak direction trips are lightly utilized. As a result, and as shown in Table 9-1, performance in terms of boardings per vehicle mile is below the MBTA standard for the route as a whole during the school and PM peak periods. As with Route 300, the relatively long mileage contributes to the low boardings per vehicle mile figures, but because operating speeds are high, the boardings per vehicle hour figures are well above the MBTA standard.

Eighty-six percent of all Route 301 riders live in Allston-Brighton, and most trips are to and from the Financial District (46 percent), Government Center (23 percent) or Park Square (14 percent). A large majority of all trips are made for work purposes (92 percent) and most riders walk to and from the bus at both ends of their trip.

Figure 9-1



Route Variations

Route 301.0 AM Brighton Center - Downtown Boston inbound via Newton Corner; outbound via Union Square
Route 301.0 PM Brighton Center - Downtown Boston inbound via Union Square; outbound via Newton Corner
Route 301.1 Brighton Center - Downtown Boston via Newton Corner
Route 301.2 Brighton Center - South Station via Union Square

Table 9-1
Route 301 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:35AM - 9:30AM and 1:48 PM - 7:25 PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 301.0	8.5	64	4	5T	–	15	2T	543.4	28.4
Rt 301.1	10.3	31	–	1T	15	8	–	317.0	16.2
Rt 301.2	5.8	1	–	–	1T	–	–	5.8	0.6
Total:		**96**	**4**	**9**	**30**	**7**	**2T**	**866.2**	**45.2**

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 301.0	1,490	2.8	2.3	--	2.4	52.3
Rt 301.1	730	--	1.9	2.2	2.5	45.3
Total:	**2,220**	**2.8**	**2.2**	**2.2**	**2.5**	**49.8**

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 301.0	$373,750	$283,000	$90,750	75.7%	$0.24
Rt 301.1	$214,750	$139,500	$75,250	64.9%	$0.41
Rt 301.2	$6,500	NA	NA	NA	NA
Total	**$595,000**	**$422,250**	**$172,750**	**71.0%**	**$0.31**

Other
Percent of passengers 65 or older: 3.4%
Percent without a car available for trip: 44.2%
Peak Load Points: Inbound: Surface Artery @ Kneeland Street
Outbound: Mass Pike off-ramp @ Kneeland Street

As with most express routes, transit dependency on Route 301 is low. Fifty-six percent of all riders have a car available but choose to ride the bus instead, only two percent are 17 or younger, and less than four percent 65 or older. In addition, fewer than 27 percent have household incomes of less than $20,000 per year.

SERVICE COVERAGE

Overall Assessment

Route 301 was instituted in 1969 along with Route 57 to replace the discontinued service on the A branch of the Green Line (the Watertown Trolley route). Route 301 and its variations provide direct service between Brighton and Downtown Boston and is the second most heavily utilized route in the WESTBus corridor with 2,220 passenger trips per weekday. The market directly served is large, with 2,600 work trips within a quarter-mile of the route. Combined with Route 57, the overall transit market share is high at over 57 percent of all work trips. Further, most riders are able to walk to and from the route at both ends. Only two percent of Route 301's riders transfer with another route; most of these are with Route 57.

At the downtown end of the route, most riders travel to the Financial District (46 percent), Government Center (23 percent), or Park Square (13 percent). As is the case with other express routes, the Park Square area is the only area of the three without direct service. Service could be added to the Park Square area though the implementation of new service, or a deviation of existing trips. However, the re-routing of existing trips increase trip times for existing Route 301 riders, most of whom are satisfied with the way the route now operates.

Most Route 301.0 service operates essentially as a one-way loop, with peak direction trips operating through Newton Corner, and reverse direction trips operating through Union Square (AM: outbound via Union Square, inbound via Newton Corner; PM: outbound via Newton Corner, inbound via Union Square). Although the reversal of the AM and PM "loops" results in a somewhat confusing route, this operation avoids peak direction delays through Union Square in Allston, and provides shorter trip times to most passengers than would the more direct alignment along Cambridge Street.

The exception to the loop operation is variation 301.1, which operates only in the afternoon through Newton Corner in both directions. Non-peak direction ridership on variation 301.1 between Brighton Center and Newton Corner is extremely low. Therefore, as discussed below, without leaving any existing riders unserved, the route could be simplified and made more efficient by eliminating the 301.1 variation and operating these trips instead as Route 301.0

Expanded Service Coverage in Boston to the Back Bay, Park Square and Beacon Hill

As discussed in the previous chapter, the Back Bay, Park Square and Beacon Hill areas are the work destination of 36 percent of the WESTBus area's residents that work in downtown Boston. However, these areas are not connected by direct transit service. As with Route 300, three options for service to these areas would be most likely: (1) service to Park Square, (2) service to Federal and Franklin Streets via Park Square, and (3) service through Park Square around Boston Common to Park Street Station (see Figure 9-2).

At service levels comparable to those now provided on Route 301, these new services could increase bus ridership to Park Square and Beacon Hill by only 205 to 285 trips per weekday (see Table 9-2). These ridership levels would be too low to justify the implementation of a new route, so that the re-routing of existing service via Park Square would be the most realistic option. This alignment would not serve Beacon Hill, so that only 205 new trips would be attracted. Further, the re-routing of existing service via Park Square would increase travel times for existing riders by four to six minutes in each direction. This travel time increase would discourage seven to eight percent, or 170 of the existing riders from continuing to use the route, so that the net gain would be only 35 trips per weekday.

Table 9-2
Weekday Ridership Impacts of Route 301 Service to the Back Bay/Park Square/Beacon Hill

	Park Square	Beacon Hill	Loss to Fed/Frank	Total	Increase
• Current Route 301	300	25		325	NA
• New Service to Park Square	505	25		530	205
• New Service to Park Street	540	70		610	285
• Re-route via via Park Square	505	25	-170	360	35

In addition, much of the "new" ridership to Park Square or Beacon Hill would be current transit users that would shift from Route 57 and the Green Line. Route 57, which operates between Watertown Square and Kenmore Square, travels along the same alignment as Route 301 and provides

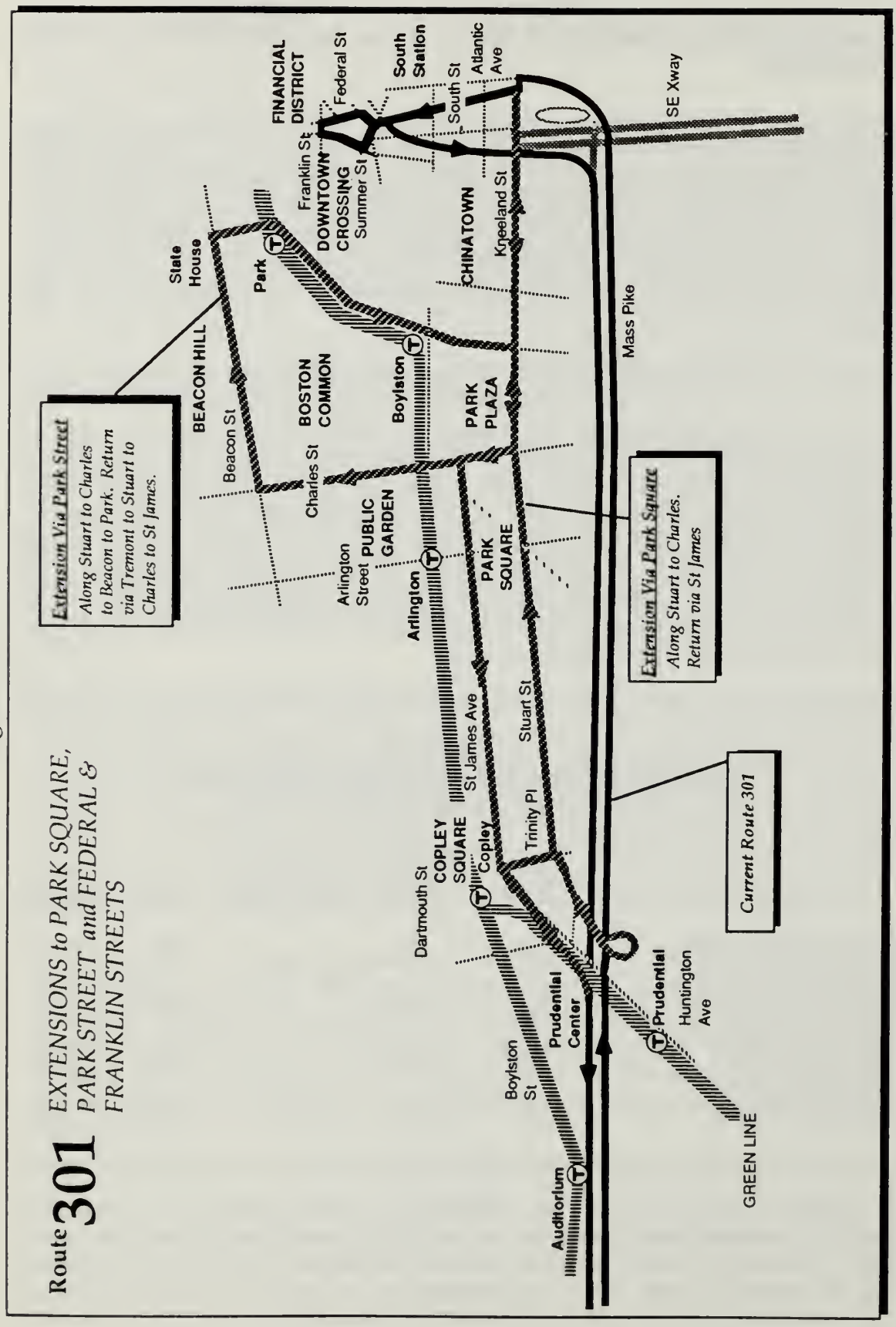

Route 301
EXTENSIONS to PARK SQUARE, PARK STREET and FEDERAL & FRANKLIN STREETS
Extension Via Park Street
Along Stuart to Charles to Beacon to Park. Return via Tremont to Stuart to Charles to St James.
Extension Via Park Square
Along Stuart to Charles. Return via St James
Current Route 301
State House
BEACON HILL
Beacon St
Park
BOSTON COMMON
Charles St
Arlington Street
PUBLIC GARDEN
Arlington
Boylston
PARK PLAZA
PARK SQUARE
FINANCIAL DISTRICT
Franklin St
DOWNTOWN CROSSING
Summer St
Federal St
South Station
South St
Atlantic Ave
CHINATOWN
Kneeland St
SE Xway
Mass Pike
Dartmouth St
COPLEY SQUARE
Copley
St James Ave
Trinity Pl
Stuart St
Boylston St
Prudential Center
Prudential
Huntington Ave
Auditorium
GREEN LINE

Figure 9-2

connections to the Back Bay, Park Square and Beacon Hill via the Green Line at Kenmore Station. Based on data collected for the Central North Bus Study, 1,240 trips per day are made on Route 57 to the Back Bay, Park Square, and Beacon Hill, most of which involve a Green Line transfer. Therefore, an extension or re-routing of Route 301 would provide a one seat ride to these areas whereas current service does not. As a result, current riders of Route 57 and the Green Line would shift to Route 301.

Since mostly Route 57 riders would be served by a re-routing of Route 301, an alternative to provide improved service to the Back Bay, Park Square and/or Beacon Hill would be an extension of some or all Route 57 trips to Park Square or Park Street instead of a re-routing of Route 301. This has not been examined in depth in this study, but based on the the relative levels of demand on Route 301 versus Route 57, an extension of Route 57 service would provide direct service for many more riders than would a re-routing of Route 301.

Operation of Variation 301.1 Trips as Variation 301.0

Route 301.1, which operates only in the afternoon and PM peak, runs via Newton Corner in both directions (as opposed to the afternoon alignment of Route 301.0 which operates inbound via Union Square). Inbound travel times on Route 301.1 through Newton Corner average 28 minutes, compared to 19 minutes on Route 301.0 through Union Square.

Ridership on the Route 301.1 inbound trips is extremely low, at an average of less than one passenger per trip and a maximum of four. Based on these ridership figures and the shorter inbound travel time through Union Square, it would be more efficient to operate all trips as Route 301.0 to allow buses to be cycled more quickly. Existing riders could be served instead by the outbound Route 301.0 trips that continue through Brighton Center into downtown Boston along Cambridge Street.

As discussed below in the "Reliability" section, cycle times on Route 301.0 trips need to be increased from 60 minutes to 66 minutes, which would require two additional vehicles. However, the operation of Route 301.1 trips as Route 301.0 trips would reduce cycle times on these trips from up to 77 minutes on to 66 minutes. These reductions would allow the necessary cycle time increases on other Route 301.0 trips without requiring additional vehicles.

LEVEL OF SERVICE

Route 301 operates at an average of four minute headways in the AM peak, 30 minutes in the school period, and eight minutes in the PM peak. During

these periods, peak loads average 40 or less (see Table 9-4), but overcrowding occurs on specific trips, with loads of up to 74 passengers. Further, counts were conducted when mostly older buses were used on the route with seating capacities of 48 to 52 passengers. With the increased deployment of RTS II buses with 40 seats, load factors will be as high as 1.85.

Table 9-4
Route 301 Peak Loads

	AM Peak		Base		School		PM Peak		Evening	
	In	Out	In	Out	In	Out	In	Out	In	Out
301.0	34	8	22	3	–	–	1	43	--	50
301.1	–	–	–	16	4	26	1	39	0	23
Average	**34**	**8**	**22**	**9**	**4**	**26**	**1**	**40**	**0**	**32**

In the AM peak, most inbound trips operate with standing loads between 7:30 AM and 8:10 AM, with average loads of 48 passengers. During this period, buses operate at four minute headways except between 8:04 and 8:12, when there is an eight minute gap. This gap is in the middle of the peak half-hour, and results in loads of over 70 passengers on the 8:12 AM departure. To reduce overcrowding on this trip, an 8:08 AM inbound departure should be added so that four minute headways are provided throughout the peak half-hour. This additional trip could be provided without adding an additional vehicle by re-scheduling existing service.

During the PM peak, combined headways on Routes 301.0 and 301.1 vary from three minutes to ten minutes.[42] As would be expected, the shorter headways are provided during the middle of the period, and the longer headways around the fringes. The heaviest loads occur after 5:18 PM when headways shift from three minutes to ten minutes. On the next three departures (5:18, 5:28 and 5:38), peak loads average 61 passengers. To reduce these loads to 46, which would be within the seated capacity of the older buses, one trip would need to be added. With one additional trip, headways could continue at three minutes until 5:18 PM, then shift to 7.5 minutes until 5:38 PM, and then shift to ten minutes thereafter.

[42]For complete schedule information and summaries of ridership by trip, see Technical Supplement 1.

RELIABILITY

During both peak periods, actual running times exceed MBTA book times in one or both directions. In addition, there is also a large degree of running variability between successive Route 301 trips. As shown in Table 9-5, these two factors combined result in poor on-time performance on the route. When observed, 20 of 95 weekday trips (21 percent) left three or more minutes late. Of these, 16, or 17 percent, were more than five minutes late.

Table 9-5
Route 301 On-Time Departure Performance
(Variations 301.0 & 301.1 Combined)

	> 2 Min Early	3-5 Min Late	> 5 Min Late	On-Time	# Trips Observed
Inbound					
AM Peak			4%	96%	27
Base			17%	83%	6
School				100%	1
PM Peak			31%	69%	13
Evening	—	—	—	100%	1
All Day			13%	87%	48
Outbound					
AM Peak	5%	5%	20%	70%	20
Base				100%	2
School		75%		25%	4
PM Peak	6%		22%	75%	18
Evening	—	—	67%	33%	3
All Day	4%	9%	21%	66%	47
All Day Both Dir:	**2%**	**4%**	**17%**	**77%**	**95**

In the AM peak, average outbound running times on Route 301.0 exceed book times by five minutes (20 minutes versus 15 minutes), and in the PM peak, the round trip running time is four minutes higher than the allowed time (see Table 9-6). On Route 301.1, PM peak round trips running times also exceed scheduled times by four minutes. The result of these higher running times is that, on average, inadequate recovery time is allowed between trips on Route 301.0 during both peak periods, and on Route 301.1 during the PM peak.

Due to the high degree of running time variability on Route 301, relatively large amounts of recovery time need to be scheduled to provide a high degree

Table 9-6
Route 301 Schedule Statistics

	Route 301.0		Route 301.1		
	6:30AM-10:59AM	2:30PM-6:59PM	9:00AM-3:59PM	4:00PM-5:59PM	6:00PM-6:59AM
Inbound					
Scheduled Run Time	25	16	23	25	23
Observed Run Time	25	19	22	28	23
STD of Obs Run Times	3.6	4.1	--	7.9	1.4
Outbound					
Scheduled Run Time	15	30	30	30	30
Observed Run Time	20	31	30	31	24
STD of Obs Run Times	3.1	6.7	1.0	4.0	1.4
Round Trip					
Scheduled Cycle Time	52	60	64	62	62
Sched RT Run Time	40	46	53	55	53
Obs RT Run Time	45	50	52	59	47
Sch Cycle/Run Time	1.30	1.30	1.21	1.13	1.17
Obs Cycle/Run Time	1.15	1.20	1.23	1.05	1.32
Sch Recovery Time	12	14	11	7	9
Obs Recovery Time	7	10	12	3	15
STD * 1.5 (min)	10	16	NA	18	4

of reliability. To insure that 90 percent of all trips will depart on-schedule, recovery time should be set at 1.5 times the standard deviation of the average running time for the time period. As shown in Table 9-6, this would require 23 minutes of recovery time for each AM peak round trip and 16 minutes in the PM peak on Route 301.0, and 18 minutes in the PM peak on Route 301.1. At present, from seven to 14 minutes is scheduled, but due to longer running times, an average of only three to ten minutes is actually available.

To provide the needed amount of recovery time would require that cycle times be increased, which, in turn, would increase vehicle requirements. On Route 301.0, AM peak cycle times would need to be increased from 52 to 55 minutes, and PM peak cycle times would have to be increased from 60 minutes to 66 minutes. On Route 301.1, PM peak cycle times would need to be increased from 62 minutes to 77 minutes. These changes would increase vehicle requirements by one on Route 301.0 during both periods, and by two on Route 301.1 in the PM peak. Operating costs would increase by $48,200 per year.

10. Routes 302 & 304

Route 302.0 *Watertown Square - Copley Square*
Route 304.0 PM *Watertown Square - Federal and Franklin Streets*
Route 304.1 *Newton Corner - Federal and Franklin Streets*

ROUTE PROFILES

Route 302

Route 302 operates between Watertown Square and Copley Square via Newton Corner and the Prudential Center (see Figure 10-1). When WESTBus ridechecks were performed in the Spring of 1986, there was only one variation of the route (302.0), but since that time, an old variation, 302.1, has been revived. This variation uses the same alignment as Route 302.0, except the inner terminal, and thus the layover point, is in front of the Prudential Green Line Station instead of the Copley Green Line station. In addition, AM peak period headways have been shortened from 12 minutes to 10 minutes.

On an all day basis, total ridership on Route 302 is 1,330 trips per day. As with the other express routes, peak period, peak direction trips are well utilized, but reverse commute and off-peak trips are lightly utilized. As a result, performance in terms of passengers per vehicle mile is above the MBTA standard during peak periods, but below during mid-day periods (see Table 10-1).

Most Route 302 riders live in the Newton Corner area (21 percent) or in Watertown (43 percent), and travel to the Back Bay/Prudential Area (66 percent). Most riders walk to and from the bus between Watertown Square and Newton Corner (62 percent), but 29 percent transfer to/from another bus and seven percent (90 persons) drive to the route and park on the streets around Newton Corner and Watertown Square. The bus transfers at the outer end involve Routes 53 (20 transfers per day), 54 (40), 57 (25), 58 (10), 70 (55), and 71 (90). At the inner end, most riders walk to and from the bus (85 percent), and eight percent transfer to/from the Green Line (including replacement service on Route 39).

Figure 10-1

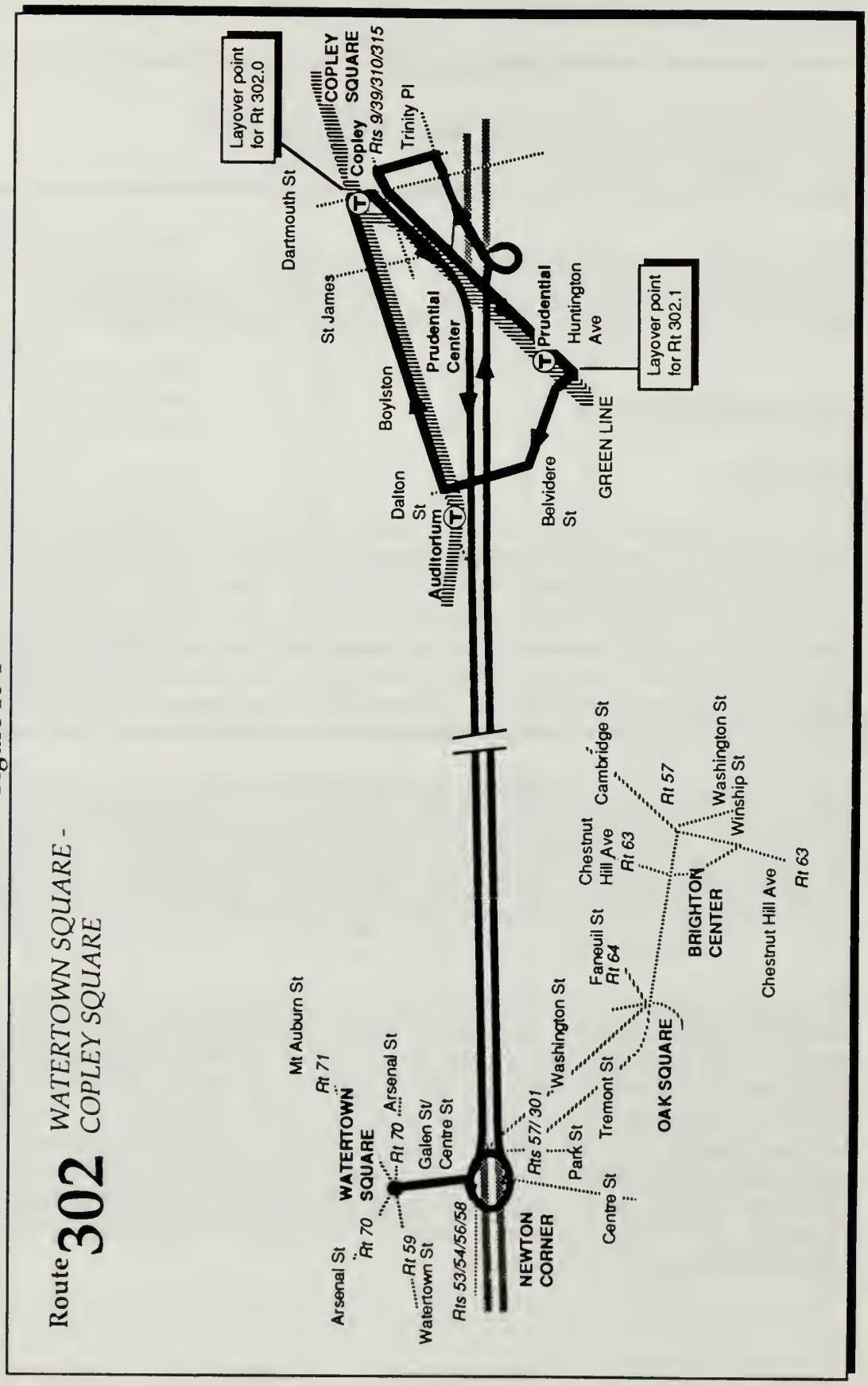

Route 302 WATERTOWN SQUARE - COPLEY SQUARE
Layover point for Rt 302.0
COPLEY SQUARE
Copley
Rts 9/39/310/315
Trinity Pl
Dartmouth St
St James
Boylston
Prudential Center
Prudential
Huntington Ave
Layover point for Rt 302.1
GREEN LINE
Dalton St
Auditorium
Belvidere St
Mt Auburn St
Rt 71
WATERTOWN SQUARE
Rt 70
Arsenal St
Rt 70
Arsenal St
Rt 59
Watertown St
Galen St/ Centre St
Rts 53/54/56/58
NEWTON CORNER
Rts 57/301
Washington St
Park St
Tremont St
Centre St
Faneuil St
Rt 64
OAK SQUARE
Chestnut Hill Ave
Rt 63
Cambridge St
Rt 57
BRIGHTON CENTER
Washington St
Winship St
Chestnut Hill Ave
Rt 63

Table 10-1
Route 302 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:58AM - 6:36PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 302	7.7	65	10	60	30	12	20	498.9	29.1

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 302	1,330	4.0	1.2	1.9	4.0	45.8

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 302	$427,040	$277,393	$149,647	65.0%	$0.42

Other
Percent of passengers 65 or older: 2.0%
Percent without a car available for trip: 51.9%
Peak Load Points: Inbound: Copley Square @ St. James Street
Outbound: Dartmouth Street @ Copley Square

There is a relatively low level of transit dependency on Route 302, but it is higher than on other express routes in terms of the number of riders without a car available (52 percent). However, 86 percent are licensed drivers, and very few are younger than 18 (one percent) or 65 or older (two percent). Household income levels are also relatively high with only 28 percent less than $20,000 per year.

Route 304

Two variations of Route 304 provide express service to Downtown Boston. The major variation, Route 304.0, operates between Watertown Square and Downtown; the second, Route 304.1 (304A), supplements Route 304.0 service between Newton Corner and Downtown (see Figure 10-2). Many Route 304.1

Figure 10-2

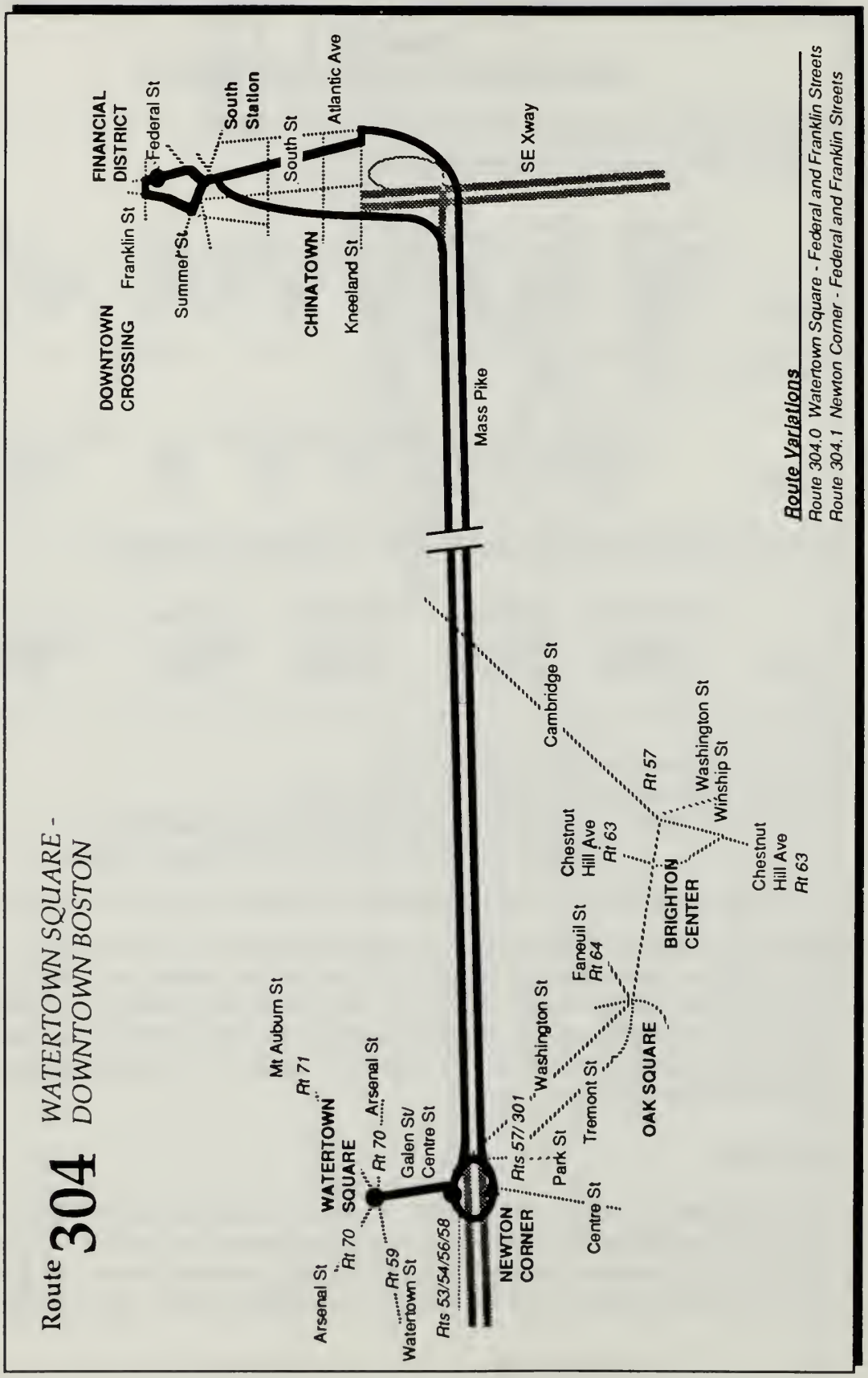

Route 304 WATERTOWN SQUARE - DOWNTOWN BOSTON
FINANCIAL DISTRICT
DOWNTOWN CROSSING
Franklin St
Federal St
Summer St
South Station
South St
Atlantic Ave
CHINATOWN
Kneeland St
SE Xway
Mass Pike
Cambridge St
Mt Auburn St
Rt 71
WATERTOWN SQUARE
Rt 70
Arsenal St
Rt 70
Arsenal St
Rt 59
Watertown St
Galen St/ Centre St
Rts 53/54/56/58
NEWTON CORNER
Rts 57/301
Washington St
Park St
Tremont St
Centre St
OAK SQUARE
Faneuil St
Rt 64
Chestnut Hill Ave
Rt 63
Rt 57
Washington St
Winship St
BRIGHTON CENTER
Chestnut Hill Ave
Rt 63
Route Variations
Route 304.0 Watertown Square - Federal and Franklin Streets
Route 304.1 Newton Corner - Federal and Franklin Streets

Table 10-2
Route 304 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:40AM - 7:48PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 304.0:	8.6	107	7	30	21	9	22	920.2	52.2
Rt 304.1:	8.2	76	7	30	30	10	15	619.4	30.1
Total:		**183**	**4**	**15**	**11**	**5**	**13**	**1539.6**	**82.3**

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 304.0:	2,440	3.5	2.3	1.7	2.5	46.8
Rt 304.1:	1,380	3.1	1.5	1.4	2.9	45.9
Total:	**3,820**	**3.3**	**1.9**	**1.6**	**2.6**	**46.5**

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 304All	$1,202,100	$788,500	$413,600	65.5%	$0.43

Other
Percent of passengers 65 or older: 3.7%
Percent without a car available for trip: 28.3%
Peak Load Points: Inbound: Newton Corner
Outbound: Surface Artery @ Kneeland St.

trips are also through-routed with Routes 53, 54, 56 and 58 local trips. The combined service level on both variations is 183 trips per day, almost double that of any other WESTBus route, providing frequent service throughout the day. Ridership is also the highest, at 3,820 trips per day.

Nearly 80 percent of all Route 304 riders live in Newton (66 percent) or Watertown (13 percent). However, although most riders live in the two communities directly served by the route, most live beyond a quarter-mile of the route. In this respect, the route has a service area more typical of rail

service than a bus route. Fewer than half of the route's riders walk to and from the route at the outer end, while 22 percent make a bus transfer, 18 percent (650 persons) drive and park in the vicinity of Newton Corner and Watertown Square, and 13 percent are dropped off and/or picked up. Almost 90 percent of all trips are to Downtown Boston for work purposes.

Most Route 304 riders use the route by choice; very few are transit dependent. Only 28 percent do not have a car available, less than one percent are under the age of 18, less than four percent are 65 or older, and 93 percent are licensed drivers. The route's riders are also relatively affluent: 82 percent have household incomes of greater than $20,000, 60 percent greater than $30,000 and 36 percent greater than $50,000.

SERVICE COVERAGE

Overall Assessment

Routes 302 and 304 provide very direct service from Watertown Square and Newton Corner to the Back Bay and downtown Boston. On Route 302, the market directly served is small (only 460 work trips per day), but because service is frequent and direct, it is the fastest transit alternative to the Back Bay from much of Newton, Waltham, and Watertown and attracts riders from beyond its immediate service area. At the outer end of the route, 81 percent of all riders making work trips transfer from another bus, drive to the route, are dropped off, or walk more than one-quarter of a mile to the route.

Route 304 is very similar, except that many more riders drive to the route and park in the vicinity of Newton Corner or Watertown Square. On Route 304, 18 percent of all riders access the route in this manner, compared to seven percent on Route 302. In total, 355 Route 304 riders park at the end of the route, the large majority of whom are from Newton (78 percent), or Watertown (11 percent).

From the WESTBus area, transit ridership to Boston is roughly proportional to the amount of transit service provided. From the Watertown Square and Newton Corner areas, where the highest level of service is provided to downtown Boston (via Route 304), 64 percent of all work trips are on transit. To the Back Bay, where service levels on Route 302 are high, but significantly lower than on Route 304, 30 percent of all work trips are on transit. To Park Square and Beacon Hill, which are not directly served and one-half mile or more from the closest direct service, the transit shares fall to 20 percent and 13 percent, respectively. Based on these characteristics, and considering that Routes 302 and 304 can attract riders from a fairly large area, the following actions could increase ridership by improving access to and from the routes:

- Expand service coverage in Boston by extending Route 302 from Copley Square to Park Square, Park Street, or downtown Boston at Federal and Franklin Streets, in order to better serve Park Square and Beacon Hill.

- Expand service coverage in the Newton, Waltham and Watertown areas by through-routing Routes 302 and 304 with one or more of the local WESTBus routes.

- Extend Route 304 from Watertown Square to Waverley to provide connections between Watertown Square and Waverley Square, and to and from Boston, from areas that are not now served.

- Provide additional parking at Newton Corner to increase the number of park and ride passengers.

Boston Extensions of Route 302

At the Boston end of the route, an extension of Route 302 from Copley Square would be governed to a great extent by local traffic conditions and the availability of a suitable layover point. In this respect, three extensions could be implemented fairly easily (see also Figure 10-3): (1) an extension from Copley Square to Federal and Franklin Streets along the alignment served by Route 310, (2) an extension to Park Square (also along the alignment of Route 310 to that point), and (3) an extension to Park Street Station around Boston Common with a layover point in Park Square.

As shown in Tables 10-3 and 10-4, and discussed in the following sections, these extensions could increase ridership by 385 to 725 trips per day (29 percent to 54 percent). Further, Route 302 service to Federal and Franklin Streets, and to a lesser extent to Park Street, could replace Route 304.0 service during the mid-day, which would reduce the operating deficit by up to $74,400 per year.[46] This would be possible since Routes 302 and 304 are both underutilized during the mid-day to the extent that if mid-day Route 302 headways were returned to 30 minutes, an extended Route 302 could handle existing and projected loads from both routes. The shifting of Route 304.0 riders to Route 302 during the mid-day would result in a four to nine minute increase in travel time to existing riders, but the productivity of both Routes 302 and 304.0 would increase significantly.

Extension to Park Square The shortest extension of Route 302 would be an extension only to Park Square. Buses could layover at Park Plaza, which is

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[46]Cost impacts are based upon changes from the Fall, 1987 schedule, while ridership changes are with respect to Spring 1986 ridership levels (since more recent ridership data is not available).

Figure 10-3

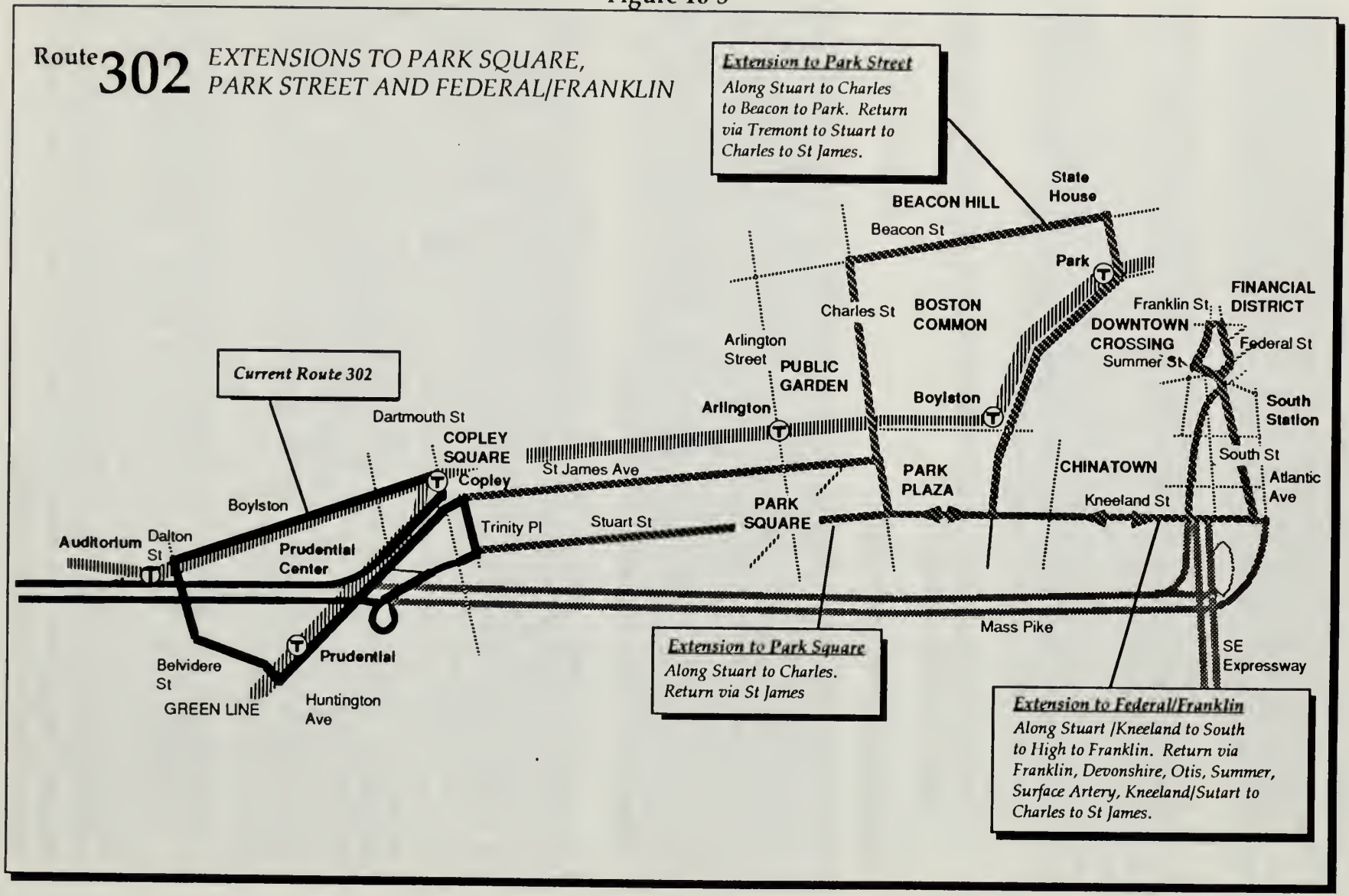
Route 302 EXTENSIONS TO PARK SQUARE, PARK STREET AND FEDERAL/FRANKLIN
Extension to Park Street
Along Stuart to Charles to Beacon to Park. Return via Tremont to Stuart to Charles to St James.
Current Route 302
BEACON HILL
State House
Beacon St
Park
FINANCIAL DISTRICT
Franklin St
Charles St
BOSTON COMMON
DOWNTOWN CROSSING
Federal St
Summer St
Arlington Street
PUBLIC GARDEN
Boylston
South Station
Dartmouth St
Arlington
COPLEY SQUARE
Copley
St James Ave
South St
PARK PLAZA
CHINATOWN
Atlantic Ave
Boylston
Kneeland St
PARK SQUARE
Trinity Pl
Stuart St
Auditorium
Dalton St
Prudential Center
Mass Pike
SE Expressway
Prudential
Belvidere St
GREEN LINE
Huntington Ave
Extension to Park Square
Along Stuart to Charles. Return via St James
Extension to Federal/Franklin
Along Stuart /Kneeland to South to High to Franklin. Return via Franklin, Devonshire, Otis, Summer, Surface Artery, Kneeland/Sutart to Charles to St James.

Table 10-3
Summary of Ridership Impacts of Boston Extensions of Route 302

	Park Square	Beacon Hill	Fin Dist/ Gov Ctr	Change fr Total	Existing
• Existing Service					
Route 302	85	20	30	135	0
Route 304	370	180	2,740	3,290	0
Total	455	200	2,770	3,425	0
• Extend Rt 302 to Park Square					
A. Continue Rt 304.0 mid-day service as is.					
Route 302	840	20	30	890	+755
Route 304	0	180	2,740	2,920	-370
Total	840	200	2,770	3,810	+385
• Extend Rt 302 to Federal/Franklin					
A. Continue Rt 304.0 mid-day service as is.					
Route 302	840	20	150	1,010	+875
Route 304	0	180	2,920	3,100	-190
Total	840	200	3,070	4,110	+685
B. Eliminate Rt 304.0 mid-day service.					
Route 302	840	20	765	1,625	+1,490
Route 304	0	180	2,215	2,395	-895
Total	840	200	2,980	4,020	+595
• Extend Rt 302 to Park Street					
A. Continue Rt 304.0 mid-day service as is.					
Route 302	840	490	30	1,410	+1,225
Route 304	0	0	2,740	2,740	-550
Total	840	490	2,770	4,150	+675
B. Eliminate Rt 304.0 mid-day service.					
Route 302	840	490	295	1,675	+1,490
Route 304	0	0	2,255	2,255	-1,035
Total	840	490	2,550	3,930	+455

currently used extensively by private bus operators as a layover point. This one-half mile extension would provide service to a growing area that is not directly served, but is the work location of a large number of WESTBus area residents. As of 1980, nine percent of all downtown Boston bound work trips from the WESTBus area were to the Park Square area (as compared to 15 percent for the Back Bay). Further, between 1980 and 1990, employment in the vicinity of Park Square has been projected to increase

Table 10-4
Service, Ridership, and Cost Statistics for Route 302 Extensions

	Headways				Vehicle	Daily	Ann Oper	Ann Fare	Operating
	AM	Base	School	PM	Req'mt	Ridership	Cost	Revenue	Deficit
•*Existing Service*									
Route 302	10	60	30	12	5	1,330	$360,300	$277,400	$82,900
Route 304	4	15	11	5	15	3,830	$1,202,100	$788,500	$413,600
Total					20	5,160	$1,562,400	$1,065,900	$496,500
•***Extend Rt 302 to Park Square***									
A.Continue Rt 304.0 mid-day as is:									
Route 302	10	30	30	12	6	2,085	$479,900	$434,900	$45,000
Route 304	4	15	11	5	15	3,460	$1,202,100	$712,300	$489,800
Total					21	5,545	$1,682,000	$1,147,200	$534,800
Increase/(Decrease)					1	385	$119,600	$81,300	$38,300
•***Extend Rt 302 to Federal/Franklin***									
A.Continue Rt 304.0 mid-day as is:									
Route 302	10	30	30	12	6	2,205	$701,600	$459,900	$241,700
Route 304	4	15	11	5	15	3,640	$1,202,100	$749,400	$452,700
Total					21	5,845	$1,903,700	$1,209,300	$694,400
Increase/(Decrease)					1	685	$341,300	$143,400	$197,900
B.Eliminate Rt 304.0 mid-day service									
Route 302	10	30	30	12	6	2,820	$701,600	$588,200	$113,400
Route 304	4			5	15	2,935	$955,700	$604,200	$351,500
Total					21	5,755	$1,657,300	$1,192,400	$464,900
Increase/(Decrease)					1	595	$94,900	$126,500	($31,600)
•***Extend Rt 302 to Park Street***									
A.Continue Rt 304.0 mid-day as is:									
Route 302	10	30	30	12	8	2,555	$707,100	$532,900	$174,200
Route 304	4	15	11	5	15	3,280	$1,202,100	$675,300	$526,800
Total					23	5,835	$1,909,200	$1,208,200	$701,000
Increase/(Decrease)					3	675	$346,800	$142,300	$204,500
B.Eliminate Rt 304.0 mid-day service									
Route 302	10	30	30	12	8	2,820	$679,200	$588,200	$91,000
Route 304	4			5	15	2,795	$955,700	$575,400	$380,300
Total					23	5,615	$1,634,900	$1,163,600	$471,300
Increase/(Decrease)					3	455	$72,500	$97,700	($25,200)

by 24 percent[47] to almost 26,000 jobs. Approximately 11 percent of these jobs will involve trips to and from the WESTBus area, totaling 5,800 one-way trips per day.

At present, only 455 trips are made daily on Routes 302 and 304 to and from Park Square (85 on Route 302; 370 on Route 304). These trips involve either a walk of approximately one-half mile or a transfer. If direct service were provided to Park Square, assuming that Route 302 could achieve the same market penetration to Park Square as to the Back Bay[48], ridership on Route 302 would increase by up to 755 trips per day, or 57 percent. Of these trips, 370 would be made by existing riders that would shift from Route 304, and 385 would be new trips (see Table 4).

With an increase of 755 trips per day on Route 302, peak loads in the AM peak would average 61 passengers throughout the period and 84 in the peak half-hour unless additional service were added. To reduce these loads to 140 percent of seated capacity during the peak half-hour and 120 percent throughout the period,[49] three trips would need to be added, two of which would need to be added during the peak half-hour. In the PM peak, where peak loads would average 87 passengers, four trips would have to be added to reduce peak loads to an average of 120 percent for the period (48 passengers). The addition of four trips would also be sufficient to reduce peak loads during the peak half hour to within standard.

Including the additional service and the extension of Saturday service as well, the annual operating cost of an extension to Park Square would be $119,600 (see Table 10-5). The new ridership would generate $81,300 in additional revenue, so that the net cost of the extension would be $38,300.

Extension to Federal/Franklin An extension to Federal and Franklin Streets would provide express service to the area between Copley Square and Federal and Franklin Streets, including Park Square and Chinatown. However, service would not be provided to Beacon Hill, as it would be with an extension to Park Street.

The extension to Federal and Franklin Streets would increase the size of the work trip market directly served by about 305 one-way trips per day, an increase of 67 percent. Based upon the market penetration characteristics of existing service on Routes 302 and 304, and depending on whether or

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[47]Metropolitan Area Planning Council projections, July 1986.

[48]In terms of work trip mode split, trip purpose, and access mode characteristics.

[49]Assuming use of RTS II buses with 40 seats, 56 passengers in the peak half hour and 48 throughout the period.

Table 10-5
Cost Impacts of a Route 302 Extension to Park Square

	Annual Impact on Operating Costs
•Extension of Existing Rt 302 Service	$31,500
•Additional Route 302 Peak Period Service	86,800
•Extension of Saturday Rt 302 Service	1,300
Total Operating Cost Impact	**$119,600**
Increase in Fare Revenue	**$81,300**
Impact on Operating Deficit	**+$38,300**

not extended Route 302 service would replace Route 304.0 service during the mid-day, the increase in trips made on Route 302 would be from 875 to 1,490 trips per day. Of these, from 505 to 595 would be new trips, and 370 to 895 would shift from Route 304. Most of the increase would be to the Park Square area (essentially the same as with an extension only to Park Square), but 130 to 300 would be new trips to the Financial District and Government Center areas attracted by the shorter effective combined headways on Routes 302 and 304.

As with an extension to Park Square, this extension would also require additional peak period service to handle increased loads. In this case, to bring loads to within MBTA standards, five trips would have to be added in the AM peak and six trips added in the PM peak. The cost of adding eight round trips would be approximately $157,000 per year.

To Federal and Franklin Streets, travel times on Route 302 would be four to ten minutes longer than on Route 304.[50] However, even with longer travel times on Route 302, the shorter combined headways should result in an increase of up to 300 trips per day (eight percent). Most of this increase would be carried on Route 304 (up to 70 percent during peak periods, slightly more than 50 percent during other periods). Further, much of this increase (170 of the 300 trips) would occur during the mid-day, when the Route 302 extension would result in the largest effective headway reduction on Routes 302 and 304 combined. During these periods, Route 302 is underutilized and would continue to be so, even

[50]Route 302 currently makes a loop around the Prudential Center that takes four to six minutes. Route 310, when it operated through Copley Square to Federal and Franklin Streets, did not make this loop. If Route 302 operated to Federal and Franklin Streets without making the loop, the additional travel time would be four minutes; with the loop, it would be eight to ten minutes.

including the ridership increase to Park Square (approximately 210 mid-day) and to downtown Boston (less than 85 on Route 302).

With Route 302 extended to Federal and Franklin Streets, service coverage along the inner end of the route between Kneeland Street and Federal and Franklin Streets would be same as that of Route 304. As a result, the excess capacity on Route 302 could be used to also carry Route 304.0's 700 base and school period trips, which in turn, would allow mid-day service on Route 304.0 to be eliminated. With existing Route 304 trips shifted to Route 302, travel times would be four to ten minutes longer for existing Route 304 mid-day riders, which would result in the loss of up to 90 of 700 existing mid-day riders. In addition, the shift of the remaining 610 Route 304 riders to Route 302 during the mid-day would require that base headways on Route 302 be returned to 30 minutes. However, the cost of returning this service would be more than offset by the savings that would result from the elimination of Route 304.0. Overall, base and school period operating costs would be reduced by $108,400, and as shown in Figure 10-6, the productivity of the remaining service would be increased significantly. Heavy average peak loads in the base period inbound and the school period outbound would be attributable to heavy loads at the fringe of the peak periods. Overcrowding could be avoided by operating Route 304.0 inbound until 9:10 AM in the morning and beginning at 3:40 PM outbound in the afternoon. On other trips, with few exceptions, all passengers would have a seat available.

Table 10-6
Peak Loads on Extended Route 302 Versus Existing Service

	Base		School.	
	In	Out	In	Out
•Existing Route 302	13	5	6	23
•Existing Route 304.0	24	12	8	19
•Route 302 to Federal/Franklin; No Route 304.0 Service Mid-day	44	21	17	54

The annual operating cost of an extension of Route 302 to Federal and Franklin Streets, including the additional peak period service required, would be $341,300. The elimination of weekday service on Route 304.0 between 9:10 AM and 3:40 PM would save $180,400 annually. On Saturdays, the elimination of Route 304.0 service (with existing passengers also carried by an extended Route 302) would save an additional $66,000. At the same time, the new ridership attracted by the extension would generate up to $126,500 in new revenue. Including this revenue, there would be a net operating cost savings of $31,600 (see also Table 10-7).

Table 10-7
Cost Impacts of a Route 302 Extension to Federal/Franklin
(w/ Elimination of Rt 304.0 Mid-day Service)

	Annual Impact on Operating Costs
•Extension of Existing Rt 302 Service	$102,500
•Additional Rt 302 Peak Period Service	157,000
•Return to 30 Min Mid-day Headways on Rt 302	71,300
•Extension of Saturday Rt 302 Service	10,500
•Elimination of Mid-day Rt 304.0 Service	-180,400
•Elimination of Saturday Rt 304.0 Service	-66,000
Total Operating Cost Impact	**$94,900**
Increase in Fare Revenue	**$126,500**
Impact on Operating Deficit	**-$31,600**

Extension to Park Street From the WESTBus area, Beacon Hill is one of the most inaccessible downtown Boston locations by transit, and the transit mode split is less than 13 percent. An extension around Boston Common would provide direct service to this area, including the State House, as well as to Park Square, Chinatown and Downtown Crossing. It would also provide service to within one-third of a mile of Federal and Franklin Streets, and to as close to Government Center as Route 304. Lastly, it would also provide a direct connection to the Red Line at Park Street. This extension would follow the alignment of Routes 43 and 55 along Charles Street, Beacon Street, Park Street, Tremont Street and Stuart Street. Buses on this extension could also layover in Park Square. At current service levels, this extension would cost $78,000.

As with an extension to Park Square, assuming that the extension to Park Street could attract the same percentage of riders to Park Square and Beacon Hill as to the Back Bay, ridership on Route 302 would increase by up to 1,225 trips per day, a 92 percent increase. However, much of this increase (up to 550 trips) would be made by existing Route 304 riders shifting to what would be more convenient service on Route 302. The number of new trips would total approximately 675, of which 385 would be to and from Park Square, and 290 would be to Beacon Hill.

This extension would not duplicate as much of the service provided by Route 304 as would the extension to Federal and Franklin Streets. Most of Chinatown, Downtown Crossing, and the Government Center would be equally served by either route, but most of the Financial District, which is

within one-quarter of a mile of Route 304, would be more than one-quarter of a mile from Route 302 at Park Street.

As a result of the lower level of duplication, it would be much more difficult to replace mid-day Route 304 service with Route 302 service to Park Street than with an extension of Route 302 to Federal and Franklin. Less than one-third (230) of Route 304's current mid-day trips would be equally well served by Route 302, and for the remainder, most (62 percent, or 290) would continue to be served by Route 304.1, but effective headways would be doubled from 15 minutes to 30 minutes. This would result in the loss of 75 of those passenger trips. In addition to those trips, there are also 180 mid-day trips to and from Watertown Square that would be more than one-quarter mile from Route 302 at the Boston end and Route 304.1 at the outer end. Currently on Routes 302 and 304, transit usage to and from areas more than one-quarter of a mile from the route is less than 20 percent of that for trips within one-quarter mile. On this basis, up to 145 of these 180 trips would then be lost. In total, the elimination of mid-day Route 304.0 service would result in the loss of 220 existing trips, which would offset much of the gain to Beacon Hill. Considering this ridership loss, the extension to Park Street coupled with the elimination of mid-day Route 304.0 service would attract 455 new trips, as opposed to the extension to Federal and Franklin Streets, which would attract 595 new riders.

As with the other extensions, the additional peak period ridership would require an increase in service. In this case, the new ridership, combined with a large shift of riders from Route 304, would require five additional AM peak trips and six additional PM peak trips. The cost of this service would be $167,100. Including the $84,500 cost to extend existing weekday and Saturday service, and 67,300 to return Route 302 to 30 minute mid-day headways, the total cost would be $318,900. The elimination of Route 304.0 weekday service between 9:10 AM and 3:40 PM and Saturday Route 304.1 service, as with the extension to Federal and Franklin Streets, would save $247,300, which would be roughly equal to the cost of the extension. The new ridership would result in a revenue gain of $108,100. Therefore, the net impact on operating costs of this extension would a savings of $25,200 per year, as shown in Table 10-8.

Of the three extensions, extensions around Boston Common to Park Street or to Federal and Franklin Streets would attract the largest ridership increases (675 to 685 trips per day). However, to attain this ridership increase, Route 304 service would have to be retained, which would mean that the net operating cost of Route 302 and 304 service would increase by approximately $172,100 per year. An extension of Route 302 to Federal and Franklin Streets coupled

Table 10-8
Cost Impacts of a Route 302 Extension to Park Street
(w/ Elimination of Rt 304.0 Mid-day Service)

	Annual Impact on Operating Costs
•Extension of Existing Rt 302 Service	$78,000
•Additional Rt 302 Peak Period Service	167,100
•Return to 30 Min Mid-day Headways on Rt 302	67,300
•Extension of Saturday Rt 302 Service	6,500
•Elimination of Mid-day Rt 304.0 Service	-180,400
•Elimination of Saturday Rt 304.0 Service	-66,000
Total Operating Cost Impact	**$72,500**
Increase in Fare Revenue	**$97,700**
Impact on Operating Deficit	**-$25,200**

with the elimination of Route 302 service could still capture most of the ridership increase (595 trips per day), and also reduce the operating deficit by $31,600 per year.

Through-Routing of Route 302 at Watertown Square

With Route 302's outer terminal at Watertown Square, local routes would have to be through-routed with Route 302 at that location. At the current time, Route 59 is the only local route to terminate there. However, as discussed in the sections on Routes 53, 54, and 58, possible changes to those routes would provide additional service to and/or through Watertown Square. These changes include a route from Brandeis/Roberts to Watertown Square through Waverley Square (Route "B"), and the operation of a truncated Route 58 from Waltham Center to Watertown Square (Route "D").

For Routes 59 and B, through-routed service with Route 302 would be an attractive alternative only for passengers on the inner ends of those routes. On Route 59/302, service would only be faster than the Green Line or commuter rail from beyond walking distance north of Newton Highlands. On Route B, any trip to the Back Bay from about half-way between Waverley Square and Waltham Center or further out would be indirect and long. On Route D, however, through-routed service would be direct from all areas served by the route, and therefore would attract riders from all of its service area. On this basis, and assuming that Park Square would also be served, these through-routings should increase the size of the work trip markets directly served by Route 302 by 305 to 665 trips per day, as shown in Table 10-9.

Table 10-9
Additional Work Trips Directly Served
by Through-Routed Route 302
(One-way Trips; Both Directions)

Route 302 Through-Routed with:	All Modes	By Transit	% By Transit
Route 59	665	145	22%
Route B (Roberts-Wat Sq)	305	35	12%
Route D (Wal Ctr-Wat Sq)	680	150	22%

At present, 12 to 22 percent of the residents that would be served use transit. From Watertown Square and Newton Corner, areas that have direct service to the Back Bay, the transit mode split is approximately 30 percent. With the through-routing of Route 302 service beyond Watertown Square, and assuming the same service levels, it is likely that the transit mode split from these areas could also reach 30 percent. However, through-routed service would actually have 30 to 60 minute headways beyond Watertown Square, which would reduce ridership. Taking into account these longer headways, and applying other characteristics of the local routes and Route 302, the through-routing of Route 302 with local routes would result in increases of from 45 to 65 trips per day, as shown in Table 10-10. These increases would occur on both the local route and Route 302.

Table 10-10
Ridership Increases Possible by Through-Routing
Route 302 with Local Routes at Watertown Square

Route Combination	Ridership Increase	Transfers Eliminated
Route 59/302	65	20
Route B/302	45	<5
Route D/302	45	5

With Route 302 currently operating at 10 minute headways in the AM peak, 30 minutes mid-day, and 12 minutes during the PM peak, Route 302 could be through-routed with any local route operating at 30 or 60 minute headways during the AM peak and mid-day. In the PM peak, to through-route Route 302 with a local route operating at a 30 minute headway, Route 302 headways would have to be revised to 10 or 15 minutes, or service provided at uneven intervals. If the PM peak through-routing were accomplished by operating

Route 302 at slightly irregular headways, and the local routes operated at 30 minute peak, 60 mid-day headways, two of the three local routes could be through-routed at no additional cost.

Through-Routing of Routes 304.0 and 304.1 at Watertown Square and Newton Corner

As discussed in the chapters on Routes 53 and 54, 56 and 58, through-routing these routes with Route 304 could increase ridership by from 15 to 65 trips per day per route and eliminate up to 120 transfers per route (see Table 10-11). Although the ridership increases would not be large, they are increases that could be realized at very little or no ongoing cost. Further, as with Route 302, these increases would be realized on both the local route and Route 304.

Table 10-11
Ridership Impacts of Through-Routing Route 304
with Local Routes at Newton Corner and Watertown Square[51]

Route Combination	Ridership Increase	Transfers Eliminated[52]
Route 56/304.1	25	90
Route 58/304.1	20	50
Route 59/304.0	65	20
Route A/304.1[53]	0	0
Route B/304.0	15	115
Route C/304.1	15	120
Route D/304.0	0	40

Currently, Route 304.1 is through-routed with most Route 53 and 54 trips throughout the day, most peak period, peak direction Route 56 trips, and some peak period Route 58 trips. All of the through-routing occurs at Newton Corner. With these combinations, nearly all Route 304.1 trips are through-routed with one of the above four local routes. Therefore, with a continuation of current route alignments and current schedules, it would not be possible to significantly increase this level of through-routing.

[51]All Route 304.0 trips would be through-routed at Watertown Square, and all Route 304.1 trips would be through-routed at Newton Corner.

[52]Includes transfers eliminated for current WESTBus riders only. Does not include transfers that may be eliminated for riders of other MBTA service that may shift to these routes.

[53]Since Routes 53 and 54 are already through-routed, the through-routing of Route A would, in effect, maintain the status quo.

Since nearly all Route 304.1 trips are already through-routed with a local trip, an increase in the number of through-routings would require changes to be local and express routes. The types of changes necessary are described in Chapter 12.

Additional Parking at Newton Corner

At present, 405 Route 302 and Route 304 riders park in the vicinity of Newton Corner and Watertown to access those routes. Combined, this represents 15 percent of the total ridership on Routes 302 and 304. As shown in Table 10-12, the large majority of those parking near the end of the routes are from Newton (73 percent).

Table 10-12
Towns of Residence of Route 302 and 304 Riders that Park Near Newton Corner and Watertown Square[54]

	Route 302	Route 304	Total	% of Total
Belmont	5	0	5	1.2%
Brighton	5	15	20	4.9%
Newton				
Auburndale	5	20	25	6.2%
Chestnut Hill	0	20	20	4.9%
Newton Centre	5	85	90	22.2%
Newton Corner	5	20	25	6.2%
Newton Highlands	0	25	25	6.2%
Newtonville	5	65	70	17.3%
Waban	0	25	25	6.2%
West Newton	0	15	15	3.7%
Total Newton	20	275	295	72.8%
Waltham	10	0	10	2.5%
Watertown	5	40	45	11.1%
Other	5	25	30	7.4%
Total	**50**	**355**	**405**	**100.0%**

At present, no MBTA parking is provided, so that most riders park on local streets or in the small City of Newton lots behind Cahner's Publishing and behind Hubbard Drugs near Centre Street. Non-metered on-street parking in neighborhoods and along Washington Street is free, but involves a walk to the bus. The City of Newton lots charge 25¢ per hour, or $2.25 to $2.50 per day for the typical commuter. Due to the charge at the pay lots, the on-street spaces fill first, but the pay lots are usually full by 8:30 AM.

[54]By zip code.

Due to these parking constraints around Newton Corner, it is probable that express bus ridership is adversely impacted. The City of Newton has discussed the development of a transportation center at Newton Corner to serve a number of different modes. At part of this plan, or only for existing local and express bus service, additional parking should be considered.

Extension of Route 304.0 to Waverley

Currently, there is no transit service within one-quarter of a mile of the area between Watertown Square and Waverley Square. As discussed in Chapter 4, one method of providing service to this area would be the implementation of Route "B" between Brandeis/Roberts and Watertown Square via Waverley Square. A second method of providing this service would be an extension of Route 304.0 trips from Watertown Square. With local trips permitted, local service could be provided between Waverley Square and Watertown, as well as direct service to Boston and connections to Cambridge via Route 73 at Waverley Square. From Watertown Square, the extension would travel along Main Street to Waverley Ave to Orchard Street to Lexington (see Figure 10-4).

With only some Route 304.0 trips extended, and service levels similar to those on through-routed local routes (30 minute headways in the AM peak, and 30 to 60 minutes throughout the rest of the day), approximately 130 trips would be attracted. Approximately one-third of these trips would be local trips, and two-thirds trips to and from Boston. With higher levels of service, such as the extension of all Route 304 trips, up to 230 trips would be attracted.

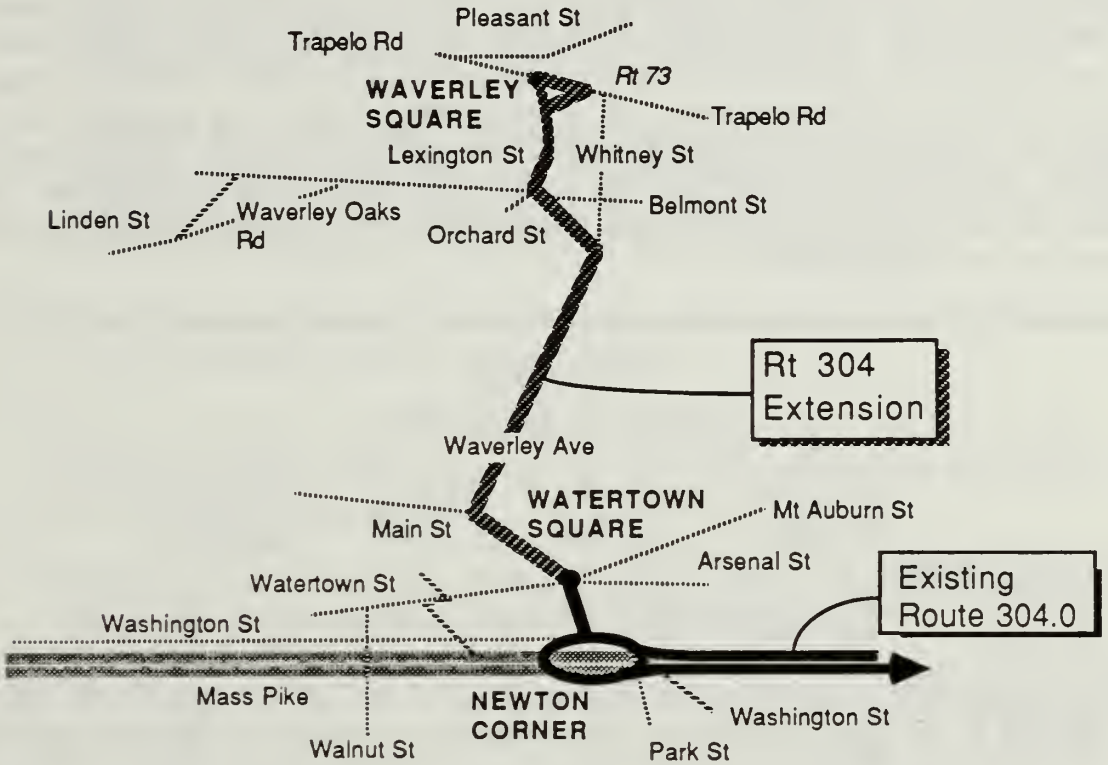
The major benefit of this extension would be more convenient service to existing riders. The increase of 45 to 75 local trips would represent new transit trips, but nearly all of the 85 to 155 trips to and from Boston would be made by those would now walk, drive or are driven to Watertown Square, Waverley Square, or other services. The cost of extending Route 304.0 service to Waverley Square would be from $55,400 and one additional vehicle for a level of service comparable to through-routed service on Route 53 or 54, to $211,800 and three additional vehicles for the extension of all Route 304 trips.

LEVEL OF SERVICE

Route 302

Route 302 is well utilized for peak period, peak direction trips, but poorly utilized during other periods and for peak period trips in the non-peak direction. With AM peak headways recently shortened from 12 minutes to 10

Figure 10-4
Route 304.0 Extension to Waverley Square



minutes, headways in both the AM and PM peaks are at a level that should provide a seat for most passengers on most trips based on the current alignment. However, as previously discussed, if service were extended to downtown Boston, five trips would have to be added during the AM peak, and six trips added during the PM peak, at a cost of $157,000 per year.

During the mid-day, if service is not extended to Federal and Franklin Streets, headways should be shortened in the base period from 60 minutes to 45 minutes. Currently, during this period, two buses are deployed to provide service at 60 minute headways, with a cycle time of 60 minutes. Based on actual running times, cycle times could be reduced to 45 minutes, which would allow the same number of vehicles to provide service at 45 minute headways.

During the school period, although peak loads are below capacity, headways should remain at 30 minutes. An increase to 45 minutes could save one round trip and one hour of vehicle time, but would increase passenger wait time by 14.4 hours for each hour of vehicle time saved. It would also result in a loss of 20 of 115 existing trips.

Route 304

Ridership on both variations of Route 304 is highly directional with sharp peaks in both the morning and afternoon. However, ridership on Route 304.0 trips is significantly higher than that on Route 304.1 trips due to heavy ridership to and from Watertown Square. At Newton Corner, most riders board the first bus to arrive, whether a Route 304.0 or 304.1. Few riders pass up a full Route 304.0 bus to wait for a Route 304.1 with a seat available. As a result, on Route 304.0, peak loads during the peak half-hour are 153 percent of seated capacity in the AM peak (61 passengers), and 125 percent in the PM peak (50 passengers), while most Route 304.1 trips operate below seated capacity (see Table 10-13).

Table 10-13
Route 304 - Peak Loads

	AM Peak		Base		School		PM Peak	
	In	Out	In	Out	In	Out	In	Out
Period Average								
Rt 304.0	49	8	24	12	8	19	9	34
Rt 304.1	38	9	13	10	6	15	6	30
Peak Half-Hour								
Rt 304.0	61							50
Rt 304.1	46							41

The unequal distribution of loads between Route 304.0 and 304.1 indicates that some Route 304.1 service should be shifted to Route 304.0. However, Route 304.1 trips are extensively through-routed with local Routes 53, 54 ,56, and 58. During the AM peak, eight of ten inbound trips are through-routed, and during the PM peak, 11 of 13 trips are through-routed. In addition, 30 of 32 mid-day trips are also through-routed. This extensive use of through-routing would prevent Route 304.1 trips from being shifted to Route 304.0 unless local routes are changed, or some of the through-routings discontinued. As a result, there would be much more flexibility in making changes to improve the productivity of Route 304 if other changes are also made. Further, since through-routed trips are successful in attracting ridership (up to 40 percent higher than on non-through-routed trips), it would be more effective to change the way local routes connect with Route 304 than to eliminate through-routing with local routes.

Level of Service Changes Made in Conjunction with Changes to Local Routes and/or Route 302 Many of the changes discussed in the sections on Routes 53, 54, 56, and 58, and in this section with respect to Route 302, would have an

impact on the level of service provided on Route 304. These changes can be summarized as follows:

- Combine Routes 53 and 54 into Route A, operating between Waltham Center and Newton Corner. This route would continue to be through-routed at Newton Corner, but at a lower level of service than the combined level of service on Routes 53 and 54 during the mid-day.

- Combine the outer ends of Routes 53 and 54 into a new route operating between Roberts/Brandeis and Watertown Square (Route B). From Watertown Square, Route B could be through-routed with Route 304.0 or Route 302, instead of at Newton Corner with Route 304.1.

- Consolidate Routes 54 and 58 into one route operating between Waverley Square and Watertown Square.

- Route the inner end of Route 58 to Watertown Square instead of Newton Corner, where it could be through-routed with Route 302 or 304.0 instead of Route 304.1.

- Extend Route 302 to Federal and Franklin Streets. This extension would allow mid-day Route 304.0 service to be discontinued.

With the changes to the local routes, as few as two routes would be through-routed with Route 304.1 at Newton Corner (Routes 53 and 56, or Routes A and 56). Approximate service levels on both of these routes would be 15 to 30 minutes peak, 60 minutes off-peak. To through-route all of these trips with Route 304.1 would require Route 304.1 to operate at 7.5 to 15 minute headways during peak periods, and 30 minute headways during off-peak periods. This could allow up to four Route 304.1 trips to be shifted to Route 304.0 during both the AM peak and the PM peak. The impacts of other route changes and the shifting of Route 304.1 trips to Route 304.0 would be as follows:

AM Peak The shifting of four AM peak trips from Route 304.1 to Route 304.0 would reduce crowding and help to equalize loads overall, but would not eliminate standing loads.[55] During the AM peak, two of the trips could be shifted during Route 304.0's peak half-hour, which would reduce peak loads from an average of 61 to 53. To reduce loads further to seated

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[55]MBTA service standards state that passengers should not be required to stand for more than 10 minutes. Using this standard, since all WESTBus express routes except Route 302 operate on the Mass Pike for more than 10 minutes and experience their peak loads there, express Routes 300, 301, 304 and 305 should provide all riders with a seat. (The seated capacity of RTS II buses is 40.)

capacity on both variations, two additional trips would still have to be added to Route 304.0 between 8:00 AM and 8:30 AM, and one trip would have to be added to Route 304.1 before 8:08 AM. These additional trips would reduce peak loads to 41 on Route 304.0 and to 37 on Route 304.1. One of these trips could be added within the number of existing vehicles assigned to Route 304, but the other two trips would require deployment of two additional vehicles. The cost of shifting four Route 304.1 trips to Route 304.0 would be $6,800 annually, and the cost to add three new round trips would be $35,600 per year, for a total of $42,400.

PM Peak During the PM peak, standing loads occur only between 5:00 PM and 5:30 PM. During the rest of the period, peak loads range from 14 to 27. As in the AM peak, the local route changes described above would allow four Route 304.1 trips to be shifted to Route 304.0; two of which would be during the peak half hour. The addition of these trips to Route 304.0 would reduce peak loads from 50 to 45. To eliminate most standees by reducing peak loads to 40, one additional trip would have to be added. This could be done without adding an additional vehicle.

Before 5:00 PM and after 5:30 PM, headways on Route 304.0 and Route 304.1 average 10 minutes with peak loads averaging 27 passengers. At these ridership levels, headways on both routes could be increased to 15 minutes (the maximum possible while maintaining through-routing with local routes). Including the loss of 40 trips due to the longer headway, passenger loads would increase to 37. Six trips per day could be saved, which would reduce operating costs by $69,500. Including the cost of providing additional service between 5:00 PM and 5:30 PM, PM peak operating costs would be reduced by $50,300.

Mid-day During the base and school periods, if Route 302 were extended from Copley Square to Federal and Franklin Streets, as previously discussed, all Route 304.0 service between 9:30 AM and 4:00 PM could be discontinued. Existing Route 304.0 mid-day riders would be served instead by Route 302. This would allow approximately 32 one-way trips to be eliminated, saving $199,000 per year.

On an all day basis, the changes described above would reduce weekday operating costs by $206,900. However, due to the increased service needed during the AM peak, two additional vehicles would be needed.

Level of Service Changes Possible Without Changes to Local Routes Without changes made to other routes, there would be much less flexibility in making changes to Route 304's level of service. First, with the continuation of current through-routing strategies, it would only be possible to shift only two Route 304.1 trips to Route 304 during each of the peak periods, as opposed to four that could be shifted with other changes. Second, without an extension

of Route 302 service to downtown Boston, Route 304 service would have to continue from Watertown Square during the mid-day.

AM Peak During the AM peak, peak loads on Route 304.0 average 49 passengers for the period and 61 during the peak half-hour (8:00 AM - 8:30 AM). On Route 304.1, the peak half-hour occurs earlier (from 7:38 AM to 8:07 AM) and peak loads average 46; for the whole period, peak loads average 38 passengers. To reduce peak half-hour peak loads on both variations to 40, it would be necessary to add three inbound trips on Route 304.0 between 7:30 AM and 8:30 AM. If combined with a shortening of cycle times[56], these three trips would require the deployment of two additional buses. The cost of adding these trips would be $37,300. If only two trips were added, peak loads could be reduced to 44 passengers and only one additional bus would be required. This would cost $24,900 per year.

PM Peak During the PM peak, headways on Route 304.0 range from 4 minutes to 10 minutes, with the shorter headways during the peak half-hour. On Route 304.1 headways are roughly 10 minutes throughout the period. This results in combined headways in the peak half hour of as short as two minutes, and five minutes during the rest of the PM peak. During the peak half hour (from 5:00 PM to 5:30 PM), the short headways are necessary, and peak loads on both variations combined average 47 passengers. However, as in the AM peak, peak loads are heavier on Route 304.0 trips to Watertown Square (50 versus 41 in the peak half-hour on Route 304.1). Further, as in the AM peak, there is little flexibility to shift Route 304.1 trips to Route 304.0 due to extensive through-routing with local routes. As a result, to reduce peak loads in the peak half-hour to close to 100 percent of seated capacity, it would be necessary to add one outbound trip. This could be done without adding an additional vehicle, at a cost of $12,400 per year.

Outside of the peak half-hour during the PM peak, peak loads average only 29 passengers. However, again, extensive through-routing of Route 304.1 trips would prevent any significant reduction in service, without also making other changes to local routes as well.

Mid-day During the base and school periods, both Routes 304.0 and 304.1 operate at 30 minute headways. Combined, this provides service to and from Newton Corner every 15 minutes. As was shown in Table 10-13, peak loads average 25 or less, and as in peak periods, loads are heavier on Route 304.0 than on Route 304.1.

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[56]As further discussed in the section on Reliability, some reductions in cycle times are possible. This would allow one additional trip to be provided in the peak half-hour without using additional vehicles.

Due to the through-routing of nearly all mid-day Route 304.1 trips (30 of 32) with Routes 53 and 54, it would not be possible to increase headways on Route 304.1 without discontinuing these through-routings. If this were done, Route 304.1 service could be discontinued during the mid-day (between 9:20 AM and 4:00 PM), with Route 304.0 service scheduled to provide close connections with Routes 53 and 54.

The elimination of Route 304.1 during this time period would impact 610 of 800 mid-day Route 304 passenger trips. A new transfer would be imposed on 140 of these trips, but if Route 304.0 trips were scheduled to coordinate with the Route 53 and 54 trips, they would otherwise be relatively unaffected by the longer headways. With close connections, the imposition of the transfer should result in a loss of less than 10 trips. For the other 470 trips affected, these would be made to and from the vicinity of Newton Corner, where effective headways would increase from 15 minutes to 30 minutes. These longer headways would result in a loss of 125 of these trips, for a total loss of approximately 135 trips per day. (The 190 trips unaffected would be from Watertown Square, where headways would be unchanged.)

Based on these ridership figures, peak loads on Route 304 would increase from between 6 and 24 during the base and school periods to from 12 to 31, as shown in Table 10-14.

Table 10-14
Route 304 - Base and School Period Peak Loads

	Base		School	
	In	Out	In	Out
Current Service				
Rt 304.0	24	12	8	19
Rt 304.1	13	10	6	15
Eliminate Rt 304.1				
Rt 304.0	33	21	12	28

Although there would be a loss of 135 trips per day, there would also be a large savings in vehicle hours of service provided. In total, 31 one-way Route 304.1 trips could be eliminated, which would save 12.2 hours of vehicle time per weekday, and $169,000 per year. Compared to the increase in passenger time that would result from longer headways (43.1 hours), there would be a cost of only 3.5 hours of passenger wait time for each hour of vehicle time saved.

On an all day basis, the changes described above that would not require other changes to the system as well, would cut overall weekday operating costs by $131,700 per year, but require two additional vehicles in the AM peak. They would also result in the loss of approximately 145 passengers (135 on Route 304 and 10 on Routes 53 and 54). By comparison, the changes that could be implemented in conjunction with other changes would save $206,900 while attracting additional riders to Route 302 and local routes.

RELIABILITY

Route 302

When observed, there were few instances of off-schedule departures in the inbound direction, but late departures were a problem in the PM peak. Between 5:00 PM and 6:00 PM, four of six outbound departures were more than three minutes late; three of these were more than five minutes late. In general, the late departures that were observed were the result of running times that are significantly longer than allowed times.

As can be seen in Table 10-15, running times in both directions during all periods currently exceed scheduled times by an average of two to eight minutes. During the PM peak, average inbound travel times have increased from 18 minutes to 22 minutes, which has effectively eliminated the four to five minutes of scheduled recovery time, thus resulting in the late departures. During other periods, the same has occurred, but not to the extent that late departures are yet occurring in significant numbers.

Although running times have increased significantly, current cycle times remain sufficient to provide reliable service during the mid-day and PM peak periods. Previously, due to scheduling constraints, cycle to run time ratios were extremely high, at up to 1.88 during the mid-day. Based on current schedules and running times, the AM peak cycle time of 50 minutes would include 8 minutes of recovery time, the mid-day cycle time of 60 minutes would provide 24 minutes, and the PM peak cycle time would provide 8 minutes of recovery time. To insure that at least 90 percent of all trips leave on time, recovery times would have to be set at 1.5 times the standard deviation of the mean running times of incoming trips during the period. At this level, 11 minutes would be required in the AM peak, 7 minutes mid-day, and 6 minutes during the PM peak. As also shown in Table 10-15, these amounts are available within existing cycle time except during the AM peak.

During the AM peak, eight minutes would be available where 11 minutes should optimally be provided. However, this would require one additional vehicle, and lateness was not observed to be a problem during this period. As

Table 10-15
Route 302 Schedule Statistics

	7:00AM-8:59AM	9:00AM-3:59PM	4:00PM-6:59AM
Inbound			
Scheduled Run Time (min)	18	18	18
Observed Run Time (min)	26	20	22
STD of Obs Run Times (min)	4.6	3.6	2.2
Outbound			
Scheduled Run Time (min)	14	14	14
Observed Run Time (min)	16	16	18
STD of Obs Run Times (min)	2.6	2.5	2.1
Round Trip			
Scheduled Cycle Time (min)	48[57]	60	48
Sched RT Run Time (min)	32	32	32
Obs RT Run Time (min)	42	36	40
Sch Cycle/Run Time	1.50	1.88	1.50
Obs Cycle/Run Time	1.14	1.67	1.20
Sch Recovery/Layover Time	16	28	16
Obs Recovery/Layover Time	6	24	8
STD * 1.5 (min)	11	9	6

a result, unless lateness problems start to become evident, current AM peak schedules appear appropriate.

Route 304

As with other routes, running times have increased slightly during most time periods, and in both directions. On Route 304, as opposed to Route 302, however, the increases have been small, at two minutes or less. In all cases, on both Routes 304.0 and Route 304.1, cycle times continue to include adequate recovery time.

However, although scheduled running times and cycle times are adequate for Route 304 itself, there are a large number of late departures on inbound Route 304.1 trips that are through-routed with Route 53. As also discussed in the section on Route 53, these late departures are caused by an inadequate

[57]Cycle time based on schedule that was in effect in the Spring of 1986, which used four vehicles to provide 12 minute headways. The recent service increase to 10 minute headways would result in the use of five vehicles and a 50 minute cycle time.

amount of scheduled running time on inbound Route 53 trips, and could be rectified by minor re-scheduling of Route 53 trips.

11. Route 305

Route 305 Waltham Center - Federal and Franklin Streets

ROUTE PROFILE

Route 305 operates between Waltham Center and downtown Boston. From Waltham, the route operates via Moody Street, Lexington Street, Commonwealth Avenue, and Washington Street to West Newton and then onto the Mass Pike (see Figure 11-1). At the Boston end, the route follows the same alignment as Routes 300, 301, and 304. Service is provided during peak periods and around the fringes of the peaks only. Total ridership on the route is 1,440 per weekday.

Most AM peak inbound service operates close to, at, or over seated capacity. However, PM peak outbound service operates below seated capacity at an average of 33 passengers per trip. In addition, ridership falls off significantly after 8:30 AM and is very low on all non-peak direction trips. As a result, performance in terms of boardings per vehicle mile and per vehicle hour is below MBTA standards during all time periods. On an overall basis, it is one of the worst performers of the WESTBus routes. Part of the poor performance is due to the route's long alignment (second only to Route 300), over much of which there are no stops, but most is due to relatively low boardings per trip.

Due to the peak period nature of the route, most trips are work trips (93 percent) and most trips are trips to Boston made by residents of Newton (42 percent) or Waltham (39 percent). Most riders walk to the route at the outer end (58 percent), but as with Route 304, a significant number of riders also drive and park along the route (32 percent, or 460 persons). At the Boston end, 84 percent of the route's riders walk to and from the bus, and 13 percent transfer to or from the rapid transit system.

Transit dependency on the route is low. Sixty-three percent of all riders have a car available, and 76 percent of all riders have household incomes greater than $20,000 per year. Four percent of all riders are 65 or older, and only 0.3 percent are under 18.

Figure 11-1

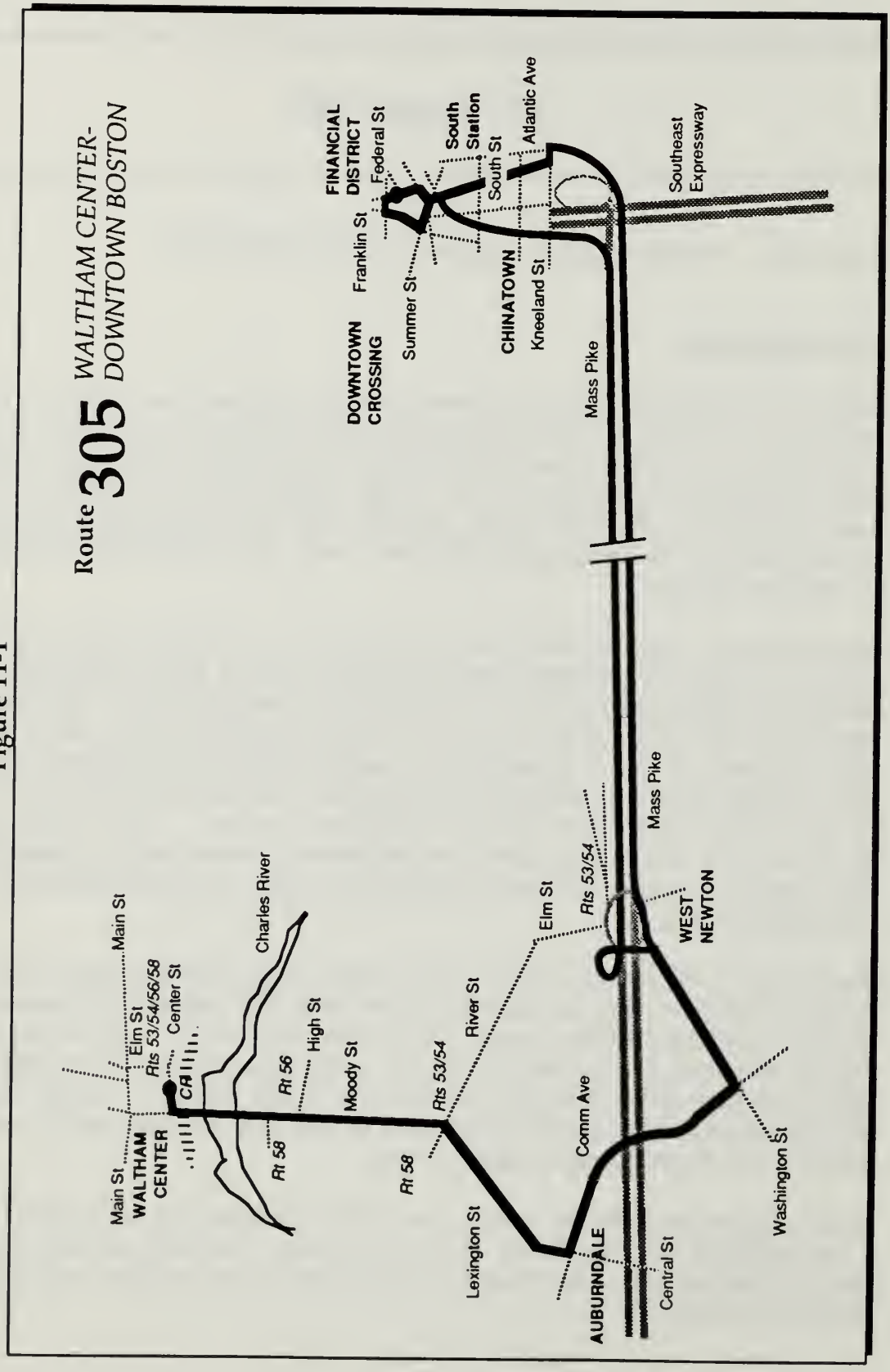
Route 305 WALTHAM CENTER-DOWNTOWN BOSTON
Main St
WALTHAM CENTER
Main St
Elm St
Rts 53/54/56/58
Center St
Charles River
Rt 56
High St
Moody St
Rt 58
Rt 58
Rts 53/54
River St
Lexington St
Comm Ave
AUBURNDALE
Central St
Elm St
Rts 53/54
Mass Pike
WEST NEWTON
Washington St
DOWNTOWN CROSSING
FINANCIAL DISTRICT
Franklin St
Federal St
Summer St
South Station
South St
CHINATOWN
Kneeland St
Atlantic Ave
Mass Pike
Southeast Expressway

Table 11-1
Route 305 Service and Ridership Statistics

Weekday Service Statistics:
Hours of Operation: 6:05AM - 10:15AM and 2:40PM - 7:20PM

	Average One-Way Length	One-Way Trips	Average Headway (Peak Dir) AM	Base	Sch	PM	Eve	All Day VSM	VSH
Rt 305	13.5	67	10	10	30	10	22	904.5	44.3

Ridership

	Weekday Boardings	Boardings/VSM AM	Base	Sch	PM	Boardings/VSH All Day
Rt 305	1,440	2.2	0.7	1.0	1.6	32.5

Financial Statistics (Annual, $1986 - All Variations Combined)

	Operating Cost	Farebox Revenue	Net Oper Cost	Farebox Return	Net Cost/ Passenger
Rt 305	$427,040	$277,393	$149,647	65.0%	$0.42

Other
Percent of passengers 65 or older: 4.1%
Percent without a car available for trip: 36.6%
Peak Load Points: Inbound: West Newton
Outbound: Surface Artery @ Kneeland Street

SERVICE COVERAGE

Overall Assessment

Route 305 provides the only "express" service from Waltham Center to downtown Boston. As such, it attracts both riders from nearby residences (58 percent) and those that live farther away and drive to the route (32 percent). However, although Route 305 is classified as express service, it does not provide the fastest bus service between downtown Boston and Waltham Center. In terms of travel time, Routes 53, 54, 56, and 58, when through-routed with Route 304.1, often provide faster service. As shown in Table 11-2,

through-routed service on Routes 56 and 58 is faster than Route 305 from Waltham Center to Boston in the AM peak, and in the PM peak, all through-routed local trips have shorter travel times.

Table 11-2
Travel Times Between Waltham Center and Downtown Boston
(in minutes)

	AM Peak Inbound	PM Peak Outbound
Route 305	37	38
Routes 53/304.1	39	34
Routes 54/304.1	39	34
Routes 56/304.1	36	36
Routes 58/304.1	35	30

Longer travel times on Route 305 are due to Route 305's somewhat indirect alignment between Auburndale and West Newton via Commonwealth Avenue and Washington Streets. However, along this alignment, the route provides service to an area of Newton (along Commonwealth Avenue and Washington Street between Auburndale and West Newton) that is not served by any other transit services. Ridership from this area is fairly high, accounting for 40 percent of Route 305's ridership (535 trips per day). As a result, considering this existing ridership, and that service is already provided along more direct routes, Route 305 should continue to operate along its present alignment.

Improved Coordination/Integration of Route 305 Service with Local Routes that are Through-Routed to Boston

Although through-routed local service can be faster, ridership to Boston is much higher on Route 305. In the AM peak, there are an average of 42 Boston-bound passengers per trip on Route 305, while only 18 on through-routed local trips. This higher utilization of Route 305 for trips between Waltham and Boston is due likely to three factors: (1) shorter headways on Route 305, (2) through-routed trips on Routes 53, 54, 56 and 58 trips are not designated as such, so that many Route 305 riders are not aware of those options, and (3) a perception that express service is faster than a combination of local and express service.

If through-routed service on local routes were better integrated with Route 305 schedules, and public awareness of these options improved, it should be possible to shift some of Route 305's riders to through-routed local routes. This would improve the productivity of the local routes, which are currently

underutilized, while allowing service to be reduced on Route 305. However, to shift service to local routes, all local service would have to be integrated with Route 305 service. Due to heavy AM peak ridership on Route 305, the integration of fewer routes could result in overcrowding on those routes. (For example, if through-routed Route 53/54 trips alternated with Route 305 at a combined headway of 7.5 minutes,[58] and assuming that these trips were viewed by riders as equivalent to Route 305, peak loads on Routes 53 and 54 in the AM peak would increase from 22 to 62.)

Scheduling/Level of Service Changes Required The integration of all local service with Route 305 would require that all peak period local trips be through-routed to Boston via Route 304, as well as a number of relatively small headway changes. In keeping with the current and/or projected ridership levels discussed in previous sections for each of the local routes, all schedules could be coordinated by operating each local route at 30 minute peak period headways after 7:00 AM, and by increasing Route 305 headways from 10 minutes to 15 minutes. At these headways, a typical sequence of departures from Waltham Center in the AM peak would be Route 305, 54, 56, 305, 53, 58, 305, 54, and so forth. The interval between all trips would be five minutes. (Before 7:00 AM when ridership is lighter and before service on all routes has begun, headways would be longer. For a typical schedule, see Figure 11-2.)

With these changes, the number of total trips (local trips plus trips to Boston) from or through Waltham Center in the AM peak would be reduced from 30 to 25, while providing the same number of trips to Boston (see Table 11-3). However, three additional Route 304.1 trips would have to be added before 7:38 AM, which is the current start of service on that route. (As further discussed below, the cost of adding these trips would be more than offset by the savings that would accrue.) In the PM peak, the total number of outbound trips would remain constant at 25, but the number of trips from Boston would increase from 24 to 25. This increase could be accomplished by rescheduling an existing Route 304.1 trip. During both peak periods, service to and from Boston would be provided at five minute headways, except before 7:00 AM.

These changes would also improve local service between the Newton Corner/Watertown Square area and Waltham. In the AM peak, headways on local service would be increased from an existing range of 25 to 60 minutes to an even 30 minutes. As shown in Table 11-3, this could be accomplished primarily through a re-allocation of existing local service, with only one

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[58]Routes 53 and 54 would each operate at 30 minute headways, and Route 305 service would be reduced from 10 minute headways to 15 minutes. The sequence to trips 7.5 minutes apart would be 53, 305, 54, 305, etc.

Figure 11-2
Typical Schedule for Coordinated Service in Waltham Center

Route	Depart Waltham	Time to Next Bus	Arrive @ Newt Cnr	Arrive @ Fed/Frank	Interval @ Fed/Frank
305	6:25	0:10		7:03	0:09
53/304.1	6:35	0:10	6:55	7:12	0:05
58/302	6:45	0:10	7:04	7:17	0:16
305	6:55	0:05		7:33	0:01
56/304.1	7:00	0:05	7:18	7:34	0:08
53/304.1	7:05	0:05	7:25	7:42	0:06
305	7:10	0:05		7:48	-0:01
58/302	7:15	0:05	7:34	7:47	0:10
54/304.1	7:20	0:05	7:40	7:57	0:06
305	7:25	0:05		8:03	0:01
56/304.1	7:30	0:05	7:48	8:04	0:08
53/304.1	7:35	0:05	7:55	8:12	0:06
305	7:40	0:05		8:18	-0:01
58/302	7:45	0:05	8:04	8:17	0:10
54/304.1	7:50	0:05	8:10	8:27	0:06
305	7:55	0:05		8:33	0:01
56/304.1	8:00	0:05	8:18	8:34	0:08
53/304.2	8:05	0:05	8:25	8:42	0:06
305	8:10	0:05		8:48	-0:01
58/302	8:15	0:05	8:34	8:47	0:10
54/304.1	8:20	0:05	8:40	8:57	0:06
305	8:25	0:05		9:03	0:01
56/304.1	8:30	0:05	8:48	9:04	0:08
53/304.1	8:35	0:05	8:55	9:12	0:06
305	8:40			9:18	

additional trip needed. In the PM peak, headways would be reduced from predominantly 60 minutes to 30 minutes. This would require the addition of five local trips through-routed from Boston. However, these trips would also carry express passengers, and replace Route 305 trips. As a result, while the total number of local trips provided would increase by 23 percent, the total number of service hours and miles provided would increase by only six to 11 percent.

Impact on Ridership to and from Boston With service configured as described above, 60 percent of Route 305's existing riders would be provided with a higher level of service, while 40 percent would have service reduced from 10 to 15 minute headways. Overall, these changes would result in an increase of 140 passenger trips per day to and from Boston, as well as an increase of from 210 to 310 local trips per weekday.[59]

[59]Depending upon whether service is provided at 30 minute headways in both directions or in the peak direction only.

Table 11-3
AM Peak Inbound Service Through or From Waltham Center

	Current Scheds		w/Coord Scheds		Change	
	Total Trips	# Thru to Bos	Total Trips	# Thru to Bos	Total Trips	# Thru to Bos
AM Peak Inbound						
Rt 53	4	2	5	5	+1	+3
Rt 54	3	3	3	3	0	0
Rt 56	4	3	4	4	0	+1
Rt 58	4	2	4	4	0	+2
Rt 305	15	15	9	9	-6	-6
Total	30	25	25	25	-5	0
PM Peak Outbound						
Rt 53	3	3	4	4	+1	+1
Rt 54	2	2	4	4	+2	+2
Rt 56	3	3	4	4	+1	+1
Rt 58	3	2	4	4	+1	+2
Rt 305	14	14	9	9	-5	-5
Total	25	24	25	25	0	+1
Totals	55	49	50	50	-5	+1

The 60 percent of Route 305's riders that would receive increased service would be those boarding or disembarking between Waltham Center and the intersection of Lexington and River Streets, where they would also be served by through-routed local service. Considering the small differences in travel times to Boston (plus or minus two minutes), and assuming that through-routed local buses are clearly marked, riders should be willing to board the first available bus. Of these riders, 185 board at Carter Street, which is served by all of the local routes, 150 others board before High Street, which is served by all local routes except Route 58, and 95 board between there and the intersection of Lexington and Rumford Streets, and would be served by Routes 53 and 54 (or Route A). For the 185 passengers boarding at Carter Street, effective headways would be reduced from 10 minutes to 5 minutes. In total, Route 58 could serve 185 Route 305 passengers, Route 56 could serve 320, while Routes 53/54 could serve 410 of Route 305's 720 riders. This increased service should result in the attraction of 230 additional passenger trips per day.

The 40 percent that would receive less service would be those boarding between the intersection of Lexington and River Streets and West Newton,

which is not served by any of the local routes. Along this segment, headways would be increased from 10 minutes to 15 minutes, which would result in a ridership loss of 90 trips per day. This loss would partially offset the increase of 230 trips closer to Waltham Center, resulting in a total increase of 140 trips per day, as shown in Table 11-4.

Table 11-4
Total Ridership Changes to/from Boston
on Routes 53, 54, 56, 58 & 305

To/From Segment	Current Rt 305 Headway	Current Rt 305 Ridership	Headways w/ Coord Services	Ridership Change
1. @ Carter St (BOL)	10	350	5	+130
2. Carter St - Moody/Maple	10	280	6	+70
3. Moody/Maple - Lexington/River	10	170	7	+30
4. Lexington/River - West Newton	10	530	15	-90
Total	**10**	**1,330**	**5-15**	**140**

During the AM peak, an additional 60 trips to Boston would be attracted by coordinated service, while in the PM peak, 30 trips would be attracted to peak direction service. These trips, plus the 640 current Route 305 AM peak inbound trips, would be distributed differentially among Routes 53, 54, 56 and 58, based upon the number of riders served by each route (see Table 11-5). Peak loads would increase on all routes during both periods with the exception of PM peak outbound service on Routes 58 and 305. On Route 58, the decrease in peak loads in the PM peak would be due to an increase in capacity (caused by the reduction in headways to 30 minutes) that would not be offset by ridership increases and the shift in ridership from Route 305. On Route 305, peak loads would be reduced slightly to 31 from a current average of 32.

During the AM peak, peak loads on Route 305 would exceed seated capacity at 51 passengers. This would be close to the normal standard of 120 percent of capacity, except that the standing loads would occur for more than 10 minutes (on the Mass Pike). To reduce peak loads to an average of 40, two trips would have to be added during Route 305's peak half-hour between 8:00 AM and 8:30 AM.

Table 11-5
Ridership Impacts of Coordinated Service by Route

	To: Rt 53	Rt 54	Rt 56	Rt 58	Rt 305	Total New Pax Trips
•*New Ridership & Shift from Rt 305*						
AM Peak Inbound	100	60	60	30	-190	60
PM Peak Outbound	40	40	30	20	-100	30
•*Peak Loads*						
AM Peak Inbound	40	40	36	24	49	
PM Peak Outbound	36	28	32	20	31	

Impact on Costs and Vehicle Requirements With coordinated service during peak periods, two fewer vehicles would be required in the AM peak, and the operating deficit would be reduced slightly.[60] In total, operating costs would increase by $29,800, but this increase would be offset by up to $52,500 in new fare revenue, for a net savings of $22,700.

During the AM peak, the number of vehicles required to provide service on Routes 53, 54, 56, 58, 304.1 and 305 would be reduced from 22 to 20, and the number of equivalent round trips[61] would be reduced from 36 to 33.5. This would reduce operating costs for the AM peak by $10,500. In the PM peak, where larger increases in local route service levels would be required (from 60 to 30 minute headways in nearly all cases), the number of round trips would increase from 30.5 to 32.5, and operating costs would increase by $40,300 annually.

Local Trips on Route 305

As discussed in the section on Route 58, ridership on the outer segment of Route 58 between Waltham Center and Auburndale is very low. Much of the same area is also served by Route 305, but local trips are not permitted.

[60]Costs for coordinated service are approximate but should be conservative. Operating costs are based on 30 minute peak direction headways for each of the local route/Route 304 combinations, and 30 to 60 minute headways in the non-peak direction. Further, a combined cycle time of 120 minutes is assumed for all local route/Route 304.1 round trips, and no interlining is assumed other than between the specific local route and Route 304.1. If actual schedules included additional interlining, effective cycle times and costs would be lower than those presented here.

[61]Equivalent round trips are the total number of one way trips divided by two.

However, if local trips were permitted, Route 305 could serve many of the trips made on the outer segment of Route 58, which would allow service there to be eliminated, while improving the productivity of Route 305.

Currently, 185 trips are made on the segment of Route 58 beyond Waltham Center. Of these trips, up to 115 could be carried instead on Routes 53, 54, and 305. Further, depending on how connections in Waltham Center were configured,[62] up to 105 of these trips would be best served by Route 305.

The impact of permitting these trips on Route 305 would be small. In both peak periods, Route 58's peak direction is the opposite of Route 305's (the peak direction on Route 58 in the AM peak is toward Waltham Center, while on Route 305, it is away from Waltham Center; in the PM peak, directions are reversed). Further, the additional trips would be carried away from Route 305's peak load point. As a result, the additional trips would not significantly impact peak loads on Route 305.

LEVEL OF SERVICE

When ridechecked, most Route 305 trips were able to provide all passengers with a seat. Of 39 observed inbound trips, only four had standing loads, and of 34 outbound trips, only two had standing loads. As can be seen in Table 11-6, peak loads are near 60 during the AM peak half-hour, but most passengers are provided with a seat during other periods. However, when surveyed, 50 percent of Route 305's passengers rated the adequacy of seating as poor or very poor, the worst rating in this category for any of the WESTBus routes.

Table 11-6
Route 305 Peak Loads

	AM Peak		PM Peak	
	In	Out	In	Out
•Period Average	42	8	5	32
•Peak Half-Hour	58			43

Further, most of the buses then being used on the route had a seated capacity of 51. With the increasing use of RTS II buses with 40 seats, standing loads will increase unless additional trips are added, or other changes are made as discussed above. Without other changes being made, use of RTS II buses will result in a doubling of the number of AM peak inbound trips carrying standing loads to eight of 15 trips. To reduce average peak loads to 40 to

[62]See Chapter 6.

provide most passengers with a seat would require the addition of two inbound trips between 7:10 AM and 8:20 AM at a cost of $35,700 per year.

RELIABILITY

On Route 305, there are a number of scattered instances of early and late departures. There is no apparent pattern to these off-schedule departures, except that some late outbound departures are caused by late arriving inbound trips during the AM peak. During this period, inbound running times average 37 minutes, compared to the book time of 35 minutes, and with actual times of up to 47 minutes. Between 8:00 AM and 8:45 AM, actual running times range from 41 to 47 minutes.

Overall, inbound running times are now longer than book times during all periods, but are often shorter in the outbound direction (see Table 11-7). On a round trip basis, cycle times provide enough recovery time to insure at least 90 percent on-time departure performance during all periods except the PM peak. In this period, an average of nine minutes recovery time was observed,

Table 11-7
Route 305 Schedule Statistics

	7:00AM-8:59AM	9:00AM-3:59PM	4:00PM-5:59PM	6:00PM-6:59AM
Inbound				
Scheduled Run Time (min)	35	29	31	29
Observed Run Time (min)	37	32	33	30
STD of Obs Run Times (min)	4.6	4.0	4.4	3.4
Outbound				
Scheduled Run Time (min)	33	31	42	31
Observed Run Time (min)	31	32	38	32
STD of Obs Run Times (min)	2.3	4.1	5.8	2.9
Round Trip				
Scheduled Cycle Time (min)	78	80	80	80
Sched RT Run Time (min)	68	60	73	60
Obs RT Run Time (min)	68	64	71	62
Sch Cycle/Run Time	1.15	1.33	1.10	1.33
Obs Cycle/Run Time	1.15	1.25	1.10	1.29
Sch Recovery/Layover Time	10	20	7	20
Obs Recovery/Layover Time	10	16	9	18
STD * 1.5 (min)	10	12	15	9

while 15 minutes would be required. To provide the additional recovery time while providing the same level of service would require that cycle times be increased from 80 minutes to 90 minutes, which would require one additional vehicle.

12. Improved Integration of Local and Express Routes

In addition to the changes to single routes or groups of routes, the efficiency and accessibility of WESTBus service could be improved through better integration of all routes within the overall system. In many respects, express and local services now exist as two separate systems serving two different types of riders. Express routes provide a high level of service, and are well utilized, while WESTBus local routes provide a low level of service and are underutilized. In general, express riders are affluent and ride express service instead of driving by choice, whereas most local riders have relatively low incomes for the WESTBus area and ride the bus because they do not have a car available.

Based on present service configurations, the disparity between the levels of service provided on the two different types of routes is justified by the different levels of demand for the two types of service. However, some of this disparity could be eliminated by increasing the use of through-routed local service for trips to Boston, and by allowing local trips to be made on express routes (as is done elsewhere in the MBTA system). In effect, this would allow many express trips to be combined with local trips, with one combined bus trip providing the same amount of service as separate express and local trips. This, in turn, would allow more of both types of service to be provided with fewer resources.

Further, by coordinating all Boston service operating at or through Waltham Center, Watertown Square and Newton Corner, an extremely high level of service could be provided to and from Boston during peak periods from three locations in the WESTBus area. (Although a high level of service is already provided from these locations, the through-routing of all local trips on specific routes and improved coordination of services could increase service levels at all three locations.) At Waltham Center, average headways to and from Boston would be five minutes during both peak periods, at Watertown Square they would be five minutes in the AM peak and eight minutes in the PM peak, and at Newton Corner, headways would be three to four minutes during both peak periods.

Overall, improved integration could increase total ridership on Routes 53, 56, 58, 59, 302, 304 and 305 by up to 620 linked passenger trips per day, while reducing operating costs by $108,100 per year. In addition, due to new

passenger revenue, the operating deficit could be reduced by up to $289,400 per year. However, due to increased ridership, two additional vehicles would be required during the AM peak.

CHANGES REQUIRED

In order for the integration of local and express routes to provide improved service as well as improve productivity, a number of changes would be required at Waltham Center, Newton Corner and Watertown Square. In general, these changes would involve the following:

- An increase in the number of local trips through-routed to Boston (including an increase in express service from Watertown Square and Newton Corner). This would allow many current Route 305 riders to be shifted to through-routed local service without degrading service for those riders. Increased use of the local routes for trips to Boston would then justify an increase in local service levels, thus also benefiting local riders. The cost of additional through-routed local service would be offset by a reduction in Route 305 trips and other accompanying service changes.

- Permit local trips to be made on express routes. This would allow duplicative service to be eliminated where local and express services overlap, and allow trips to be made to Newton Corner through Watertown Square on local routes through-routed with Route 302 or 304.0.

More specifically, the changes required would be depend upon other routing changes made to the individual routes. To maximize the number of routes with which all trips could could be through-routed would require that the inner terminal of some local routes be moved to Watertown Square. As discussed in previous chapters, and as summarized below, this could be done in a number of ways:

A. Replace Routes 53 and 54 with Routes A and B. Route A would operate between Waltham Center and Newton Corner, and Route B would operate from Roberts/Brandeis via Waverley to Watertown Square (see Chapter 4).

B. Re-route the inner terminal of Route 58 from Newton Corner to Watertown Square (see Chapter 6).

C. Eliminate the outer end of Route 58 past Waltham Center and provide service instead along the outer end of Route 53 or 54. This would then allow either Route 53 or 54 to be replaced by the modified Route 58, which would operate to Watertown Square (see Chapter 4).

The implementation of any two of these steps would reduce the number of local routes that would be through-routed at Newton Corner from four to two, while increasing the number of routes to be through-routed at Watertown Square to two or three (including Route 59). With only two local routes terminating at Newton Corner, all trips all day on both routes could be through-routed with Route 304.1. At Watertown Square, three routes could be through-routed on an all day basis if Route 302 and Route 304.0 continued to operate as they now do. If Route 302 were extended to Federal and Franklin and Route 304.0 service eliminated during the mid-day (see Chapter 10), two routes could be through-routed with Route 302 an all day basis. Any through-routing with Route 304.0 could then take place during peak periods only.

The most cost effective way of through-routing all trips on the greatest number of local routes would be the implementation of (B.) and (C.) above, with Route 58 replacing Route 58, operating between Watertown Square and Waverley. In addition, Route 302 would be extended to Federal and Franklin Streets and replace mid-day Route 304.0 service. With this change, all trips on Routes 53 and 56 would be through-routed at Newton Corner with Route 304.1, and all trips on Routes 58 and 59 could be through-routed at Watertown Square with Route 302 (see Figure 12-1).[63]

Service at Waltham Center

The shifting of express riders to through-routed local service at Waltham Center would require that through-routed local service be comparable to "express" service on Route 305. As discussed in the previous chapter, this is already the case in most respects: the total fare on though-routed local service is the same as on Route 305 and travel times are often lower. The major difference is that through-routed local trips trips have a much lower level of visibility than Route 305 trips since they are not marked as Boston trips, and not all trips are through-routed. As a result, many potential riders are likely not aware of the through-routed service, and even for those that are, it can be difficult to know which trips are through-routed and which are not. Presumably for these reasons, the utilization of through-routed local service for trips to and from Boston is much lower than that of Route 305.

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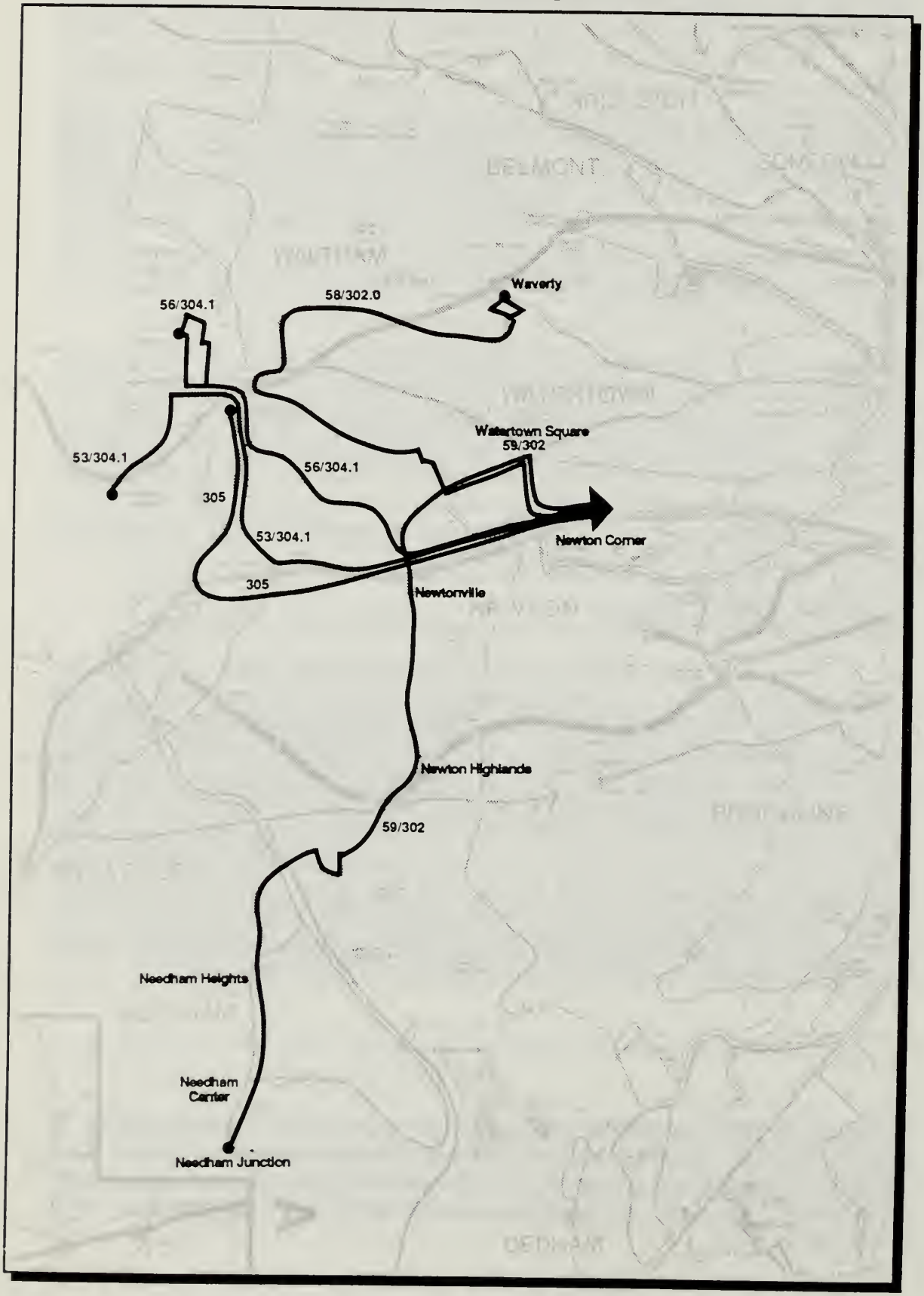
[63]This same basic scenario would also work with the implementation of Routes A and B. Routes A and 56 would be through-routed with Route 304.1 at Newton Corner and Routes B and 58 (continuing along its existing outer alignment or truncated at Waltham Center) would be through-routed with Route 302 or 304.0.

Figure 12-1
Through-Routed Local/Express Service



The most straightforward method of increasing the visibility of through-routed local service would be to through-route all trips on specific local routes, and to clearly mark these routes as such.[64] This would allow through-routed local routes to be considered in the same manner as express service on Route 305; most riders should be indifferent to whether they board a through-routed local trip or a Route 305 express trip.

With all Route 53, 56 and 58 trips through-routed to Boston, service could be coordinated with Route 305 in a similar manner as discussed in the previous chapter. Through-routed local routes would operate at 30 minute peak period headways, and Route 305 would operate at 15 minute headways. However, the consolidation of Routes 54 and 58 into a single route (designated Route 58) would eliminate two trips per hour during peak periods to and from Waltham Center, and reduce service between Waltham Center and Newton Corner along the current alignment of Routes 53 and 54 from a current average of 22 to 30 minute headways. During peak periods, to to avoid the overcrowding that would occur between Waltham Center and Newton Corner with 30 minute headways, this service would need to be replaced. This could be done by reducing Route 53 headways during peak periods from 30 minute to 15 minutes.

During mid-day periods, the same service would not need to be replaced, and the remaining Route 53 trips could carry all trips now carried by both Routes 53 and 54. As discussed in Chapter 4, both Routes 53 and 54 currently operate at 60 minute mid-day headways, resulting in an effective headway of 30 minutes along the common segment. These 30 minute headways provide more service than necessary, but are the longest possible without increasing headways to more than 60 minutes beyond Waltham Center to Brandeis and Waverley. With the consolidation of Route 54 and 58, only Route 53 would continue to operate between Waltham Center and Newton Corner along Lexington, River and Washington Streets. The remaining service on Route 53 at 60 minute headways would be sufficient to carry all trips now carried by both Routes 53 and 54.

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[64]The designation of local routes as also providing service to and from Boston could be in the form of listing both route numbers on bus headsigns and schedules (Route 53/304A, for example), or renumbering local routes as express routes (these "new" express routes would operate in the same manner as Routes 352 and 353-354 in Burlington and Woburn, carrying both local and express riders). A 300 series number would likely be more identified with Boston service than a combination of two route numbers, which could become confusing. A renumbering to express routes could also simplify the system for many users by changing many combinations of local and express routes into single new routes. (For example, a trip from Boston to Brandeis would involve, say, Route 303 rather than Route 304A and 53.)

Lastly, with Route 58 through-routed with Route 302, to provide travel times to Federal and Franklin Streets comparable to the other express services, it would be necessary to eliminate the Route 302 loop around the Prudential Center. If Route 302 continued to make the loop, the travel time to Boston from Waltham Center would be as long as 45 minutes, compared to 36 to 39 minutes on the other routes (and 37 on Route 305). This longer travel time could result in downtown bound passengers avoiding these trips, which could lead to overcrowding problems on the next downtown Boston trip. The elimination of the loop would reduce travel times to 39 minutes, within the same range as on other routes, and thus prevent potential problems with uneven loads between Waltham trips.

With the changes described above, resulting service levels to and from Waltham Center would be as described below.

AM Peak Routes 53, 56, 58 and 305 would be scheduled to provide service to downtown Boston at five minute intervals. Headways on Route 53 and 58 would be 15 minutes, and headways on Routes 56 and 305 would be 30 minutes. (In order to prevent unequal loads among Route 305 trips, Route 305 trips should be preceded by Route 53 trips.) A typical sequence of trips from Waltham Center (at five minute intervals) would be Route 305, 58/302, 53/304.1, 305, 56/304.1, 53/304.1, 305, 58/302, and so forth.

Mid-day During the base and school periods, service to Boston would depart at 15 to 30 minute headways, with 60 minute headways on Routes 53/304.1, 56/304.1 and 58/302. A typical sequence of departures would be Routes 53/304.1, 56/304.1, 58/302, 53/304.1, at intervals of 15 minutes, 15 minutes, 30 minutes, and 15 minutes. This would represent an increase of one round trip per hour to and from Boston, a reduction in service between Waltham Center and Newton Corner along Lexington, River and Washington Streets from two trips per hour to one trip per hour, and a continuation of current service levels on Route 56, the outer segment of Route 54 and the inner segment of Route 58.

PM Peak PM peak service would be a reverse of AM peak service, with service departing from Federal and Franklin to Waltham Center (and beyond) at five minute headways. As in the AM peak, headways on Routes 53/304.1 and 305 would be 15 minutes, and headways on Routes 56/304.1 and 58/302 would be 30 minutes.

During these periods, the coordination of service in this manner would increase the number of direct trips to and from Boston from a total of 127 to 145, or 14 percent, with increases occurring in all time periods. On local service, there would be an overall decrease from 108 trips per day to 102 trips.

However, all of the decrease would be due to the reduction in mid-day service along Lexington, River and Washington Streets from two trips per hour to one trip per hour. Peak period local service would increase from 47 daily trips to 57 daily trips, or 21 percent.

The shift of Route 305 riders to through-routed local routes would allow Route 305 service to be reduced by 18 trips per day. These trips would be replaced by local trips through-routed with Route 302 and 304.1 trips, requiring an increase of nine local trips and six Route 304.1 trips.

Integration of Service at Newton Corner and Watertown Square

With service to and from Waltham Center configured as described above, there would also be an increase in the number of trips between Watertown Square, Newton Corner and Boston during peak periods. Including express service that would originate at Watertown Square or via Route 59, there would be an increase of 12 peak period, peak direction trips from 75 to 87, an increase of 16 percent (see Table 12-1).

Table 12-1
One-Way Trips through Newton Corner
with Waltham Center Changes Compared to Current Schedules

	AM Peak In		PM Peak Out	
	Current	w/Changes	Current	w/Changes
Route 53/304.1	2	4	3	4
Route 54/304.1	3	4	2	4
Route 56/304.1	3	4	3	4
Route 58/304.1	2	0	2	0
Route 304.1 (only)[65]	1	0	2	0
Rt 304.1 Subtotal	11	12	12	12
Route 58/302	0	4	0	4
Route 59/302	0	4	0	4
Route 302 (only)[65]	11	8	9	7
Rt 302 Subtotal	11	16	9	15
Route 304.0	17	17	15	15
Total	**39**	**45**	**36**	**42**

[65]Not through-routed with any local trip.

However, nearly all of the service increase would be due to the addition of 11 new peak period Route 302 trips that would be needed to carry increased ridership attracted by the extension of service to Federal and Franklin, and would not represent additional capacity available to carry existing riders.

In addition, due to the shift in ridership from Route 305 to through-routed local trips, through-routed trips would arrive at Newton with heavier loads than they now do. At present, depending upon the route, an average of 11 to 19 passengers are on-board peak period, peak direction through-routed trips when they arrive at Newton Corner. With Route 305 riders shifted to local trips through-routed through Watertown Square and/or Newton Corner, the number of passengers already on board would increase to between 18 and 33, resulting in less room on-board arriving buses for those that board at Watertown Square and Newton Corner. Assuming even intervals between departures and arrivals at Newton Corner and Watertown Square, peak loads would increase in nearly all cases, and there would be extreme overcrowding on most Route 302 trips, with passenger loads of up to 98 persons.

The extremely high passenger loads on Route 302 trips would be the result of the route serving both Newton Corner and Watertown Square at the outer end of the route, and the Back Bay, Park Square, and Federal and Franklin at the Boston end. The route's primary function would be to provide service to the Back Bay, Park Square and Chinatown. However, as long as the additional travel time to Federal and Franklin via Route 302 was the same as or shorter than the interval between Route 302 and 304 trips, Route 302 would also be used for trips to Federal and Franklin Streets.[66] It would be the inclusion of these passenger trips to Federal and Franklin Streets that would cause the overcrowding on Route 302.

To prevent this from occurring, service would need to be scheduled so that Route 304 carried nearly all Federal/Franklin trips, with Route 302 carrying trips between the Back Bay and Federal and Franklin Streets not served by Route 304. This could be accomplished by scheduling Route 304 peak direction trips to depart at the same time as Route 302 trips.[67] With this

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[66]The additional travel time to Federal and Franklin would be approximately four minutes. Therefore, with an interval between Route 302 and 304.0 departures of four minutes or more, four minutes of additional travel time on Route 302 would be preferable to four minutes or more of additional wait time.

[67]An alternative method of discouraging trips to the Financial District from being made on Route 302 would be for Route 302 trips not to operate all the way to Federal and Franklin during peak periods. However, this would result in different alignments for peak and mid-day service, which could confuse riders. Also, with peak period trips operating to Federal and Franklin Streets, (Continued on next page.)

scheduling, Route 304.0 would always be a faster alternative than Route 302 to any area served by both routes, so that Route 304.0 would be chosen over Route 302 whenever possible. By time period, this would require the following service levels:

AM Peak From Waltham Center, 16 through-routed trips would pass through Newton Corner at seven to eight minute intervals. Twelve of the 16 trips would be through-routed with Route 304.1, while four would be through-routed with Route 302. To prevent these four Route 302 trips from being used for trips to Federal and Franklin Streets from Watertown Square or Newton Corner, four Route 304.0 trips would be needed to depart from Watertown Square at the same time as the Route 58/302 trips.

To alternate Route 304.0 trips originating in Watertown Square with the Route 304.1 trips at Newton Corner, 15 trips would be required operating at seven to eight minute headways. To serve peak half-hour demand (between 7:50 AM and 8:20 AM), an additional three trips would also be needed. Including these trips, and the four trips scheduled to match Route 58/302 trips, a total of 22 inbound Route 304.0 trips would be needed for AM peak service. During the peak half-hour, Route 304 headways from Watertown Square would be three to four minutes, and from Newton Corner, one to four minutes. Throughout the rest of the period, headways from Watertown Square would be three to eight minutes, and three to five minutes from Newton Corner (see Figure 12-2).[68]

For Route 302 trips to coincide with Route 304 departures, 22 inbound trips would also be needed on Route 302. As with Route 304.0, fifteen trips would provide seven to eight minute headways from Watertown Square (four of which would be through-routed with Route 59). Three extra trips would also be needed on Route 302 during the peak half hour, scheduled at the same time as the extra Route 304.0 trips. In addition, four trips would be through-routed with Route 58 and coordinated with Waltham Center departures. At both Watertown Square and Newton Corner, service would be provided at three to four minute headways in the peak half-hour, and four to seven minutes throughout the rest of the period.

In total, 56 inbound trips would be provided through Newton Corner, an increase of 18 compared to current schedules. With these service levels, projected loads at Newton Corner would be as shown in Table 12-2.

Route 302 trips could carry overflow loads from Route 304 if capacity were available.

[68]For the schedules used as the basis of Figure 12-2, see Technical Supplement 2.

Figure 12-2
AM Peak Inbound Service at Newton Corner and Watertown Square with Integrated Services

Route	Time @ Wat Sq	Time to Next 302	Time to Next 304		Time @ Newt Cnr	Time to Next 302	Time to Next 304
53/304.1					6:55		0:03
302 & 304.0	6:54	0:04	0:04		6:58	0:04	0:04
58/302 & 304.0	6:58	0:04	0:04		7:02	0:04	0:04
59/302 & 304.0	7:02	0:07	0:07		7:06	0:07	0:07
302 & 304.0	7:09	0:08	0:08		7:13	0:08	0:05
56/304.1					7:18		0:03
302 & 304.0	7:17	0:07	0:07		7:21	0:07	0:04
53/304.1					7:25		0:03
302 & 304.0	7:24	0:04	0:04		7:28	0:04	0:04
58/302 & 304.0	7:28	0:04	0:04		7:32	0:04	0:04
59/302 & 304.0	7:32	0:07	0:07		7:36	0:07	0:04
53/304.1					7:40		0:03
302 & 304.0	7:39	0:08	0:08		7:43	0:08	0:05
56/304.1					7:48		0:03
302 & 304.0	7:47	0:07	0:07		7:51	0:07	0:04
53/304.1					7:55		0:03
302 & 304.0	7:54	0:04	0:04		7:58	0:04	0:04
58/302 & 304.0	7:58	0:04	0:04		8:02	0:04	0:04
59/302 & 304.0	8:02	0:03	0:03		8:06	0:03	0:03
302 & 304.0	8:05	0:04	0:04		8:09	0:04	0:01
53/304.1					8:10		0:03
302 & 304.0	8:09	0:04	0:04		8:13	0:04	0:04
302 & 304.0	8:13	0:04	0:04		8:17	0:04	0:01
56/304.1					8:18		0:03
302 & 304.0	8:17	0:03	0:03		8:21	0:03	0:03
302 & 304.0	8:20	0:04	0:04		8:24	0:04	0:01
53/304.1					8:25		0:03
302 & 304.0	8:24	0:04	0:04		8:28	0:04	0:04
58/302 & 304.0	8:28	0:04	0:04		8:32	0:04	0:04
59/302 & 304.0	8:32	0:07	0:07		8:36	0:07	0:04
53/304.1					8:40		0:03
302 & 304.0	8:39	0:08	0:08		8:43	0:08	0:05
56/304.1					8:48		0:03
302 & 304.0	8:47	0:07	0:07		8:51	0:07	0:04
53/304.1					8:55		0:03
302 & 304.0	8:54	0:04	0:04		8:58	0:08	0:04
58/302	8:58	0:04	0:04		9:02		0:04
59/302 & 304.0	9:02	0:07	0:07		9:06	0:07	0:04
53/304.1					9:10		0:03
302 & 304.0	9:09				9:13		

Mid-day Between 9:10 AM and 3:40 PM, 30 minute headways on Route 302 from Watertown Square (extended to Federal and Franklin) and Route 304.1 from Newton Corner would be sufficient to carry projected demand. As during other periods, Routes 53 and 56 would be through-routed with Route 304.1, and Routes 58 and 59 would be through-routed with Route 302. Mid-day Route 304.0 service between 9:10 AM and 3:40 PM would be eliminated.

Table 12-2
AM Peak Passenger Loads at Newton Corner
with Integrated Services

	53/ 304.1	56/ 304.1	58/ 302	59/ 302	Other 302	304.0
AM Peak Inbound						
Number of Trips	8	4	4	4	14	22
Loads @ Newton Corner	**42**	**40**	**43**	**37**	**47**	**41**

Whereas in the AM peak, schedules would be designed to discourage use of Route 302 for trips to Federal and Franklin, the opposite would be true during the mid-day. With mid-day Route 304.0 service eliminated, Route 302 service would be designed to serve the trips now carried by Route 304.0. To do so, Route 302 trips would carry all downtown trips from Watertown Square, and up to 50 percent of the trips from Newton Corner.

During this period, due to the elimination of Route 304.0, 29 fewer trips would be operated.

PM Peak In the PM peak the sequencing of routes would be similar to that in the AM peak, except that the overall level of service would be slightly lower. Trips to and from Waltham Center would operate at the same headways as in the AM peak, but Route 302 and 304 headways would average eight to nine minutes, as compared to five minutes in the AM peak. (These longer headways are possible due to lower PM peak ridership.)

As in the AM peak, Route 302 and 304 trips would need to be scheduled to depart from Federal and Franklin at the same time in order to prevent overcrowding on Route 302 trips. With coordinated service to Waltham Center departing from Federal and Franklin every five minutes, three out of every four Waltham Center trips would also serve Newton Corner, with headways of 5, 5, 5 and 10 minutes. To fill the gap so as to provide even five minute headways to Newton Corner would require that Route 304.0 and non-through-routed Route 302 trips depart from Federal and Franklin Streets at the same time as Route 305 departures. This would result in a sequencing of departures as shown in Figure 12-3.[69]

[69]As with the AM peak, the schedules assumed in Figure 12-3 are included in Technical Supplement 2.

Figure 12-3
PM Peak Outbound Service from Federal/Franklin with Integrated Services

Route	Depart Federal/ Franklin	Time to Next Bus to Wal Ctr	Time to Next Bus to Newt Cnr	Time to Next Bus to Wat Sq		Arrive Newt Cnr	Time to Next Bus to Wal Ctr
304	4:00		0:00	0:00		4:22	
59/302	4:00		0:05	0:15		4:26	
305	4:00	0:05				NA	
56/304.1	4:05	0:10	0:05			4:27	0:05
53/304.1	4:10	0:05	0:05			4:32	0:14
304	4:15		0:00	0:00		4:37	
302	4:15		0:05	0:05		4:41	
305	4:15	0:05				NA	
304	4:20		0:00	0:00		4:42	
58/302	4:20	0:05	0:05	0:10		4:46	0:01
53/304.1	4:25	0:05	0:05			4:47	0:10
305	4:30	0:05				NA	
304	4:30		0:00	0:00		4:52	
59/302	4:30		0:05	0:15		4:56	
56/304.1	4:35	0:05	0:05			4:57	0:05
53/304.1	4:40	0:05	0:05			5:02	0:14
304	4:45		0:00	0:00		5:07	
302	4:45		0:05	0:05		5:11	
305	4:45	0:05				NA	
304	4:50	0:00	0:00	0:00		5:12	
58/302	4:50	0:05	0:05	0:05		5:16	0:01
53/304.1	4:55	0:05	0:00			5:17	0:10
302	4:55		0:05	0:05		5:21	
304	5:00		0:00	0:00		5:22	
59/302	5:00		0:05	0:07		5:26	
305	5:00	0:05				NA	
56/304.1	5:05	0:05	0:02			5:27	0:05
304	5:07		0:00	0:00		5:29	
302	5:07		0:03	0:08		5:33	
53/304.1	5:10	0:05	0:05			5:32	0:14
304	5:15		0:00	0:00		5:37	
302	5:15		0:05	0:07		5:41	
305	5:15	0:05				NA	
304	5:20		0:00	0:00		5:42	
58/302	5:20	0:05	0:02	0:05		5:46	0:01
304	5:22		0:00	0:00		5:44	
302	5:22		0:03	0:03		5:48	
53/304.1	5:25	0:05	0:05			5:47	0:10
304	5:30		0:00	0:00		5:52	
59/302	5:30		0:05	0:15		5:56	
305	5:30	0:05				NA	
56/304.1	5:35	0:05	0:05			5:57	0:05
53/304.1	5:40	0:05	0:05			6:02	0:14
304	5:45		0:00	0:00		6:07	
302	5:45		0:05	0:05		6:11	
305	5:45	0:05				NA	
304	5:50		0:00	0:00		6:12	
58/302	5:50	0:05	0:05	0:10		6:16	0:01
53/304.1	5:55	0:05	0:05			6:17	0:10
304	6:00		0:00	0:00		6:22	
59/302	6:00		0:05	0:15		6:26	
305	6:00	0:05				NA	
56/304.1	6:05	0:05	0:05			6:27	0:05

With these schedules, there would be a total of 45 outbound trips from Federal and Franklin Streets to Newton Corner and Watertown Square, a decrease of two from current levels. Peak loads on the express portions would range from 24 to 49 (see Table 12-3)

Table 12-3
PM Peak Passenger Loads at Newton Corner with Integrated Services

	53/ 304.1	56/ 304.1	58/ 302	59/ 302	Other 302	304.0
Number of Trips	9	5	4	5	7	15
Loads @ Newton Corner	**24**	**28**	**48**	**49**	**42**	**37**

Although peak loads on Route 304 would be below capacity, it would be difficult to provide less service while still coordinating service at Waltham Center, Newton Corner and Watertown. As previously mentioned, many of the Route 304 trips are needed to prevent overcrowding on the Route 302 trips, so that a reduction in Route 304 trips would require an increase in Route 302 trips. In addition, additional capacity would also be needed along the local portion of Routes 53/304.1, where loads would increase to 36.

SERVICE AND RIDERSHIP IMPACTS

With the changes described in the previous two sections at Newton Corner, Waltham Center and Watertown Square, the total number of daily trips to and from Boston would be increased from 364 to 395, while the number of local trips would be reduced from 163 to 135 (see Table 12-4). However, all of the decrease in local service would occur during the mid-day. During the peak periods, the number of local trips would increase from 70 to 75. These increases in service that would be made possible through the improved integration of local and express services would increase WESTBus ridership by 620 linked trips, or 1,220 unlinked trips,[70] per weekday, while holding operating costs essentially constant.

[70]A linked trip is one trip from origin to destination, irrespective of the number of transfers made or modes used, while unlinked trips are synonymous with boardings. Therefore, one linked trip may be composed of two or more unlinked trips. In this case, the large differential between linked trips and unlinked trips is due to the shifting of Route 305 trips to through-

(Continued on next page.)

Table 12-4
Service Statistics -
Existing Service Compared to Integrated Service

	Existing Service		Integrated Service	
	Average Headways[71]	One-Way Trips	Average Headways[71]	One-Way Trips.
AM PEAK				
Route 53	38	8	15	15
Route 54	48	7	--	0
Route 56	30	7	30	7
Route 58	34	6	30	7
Route 59	30	9	30	9
•Subtotal-Local		**37**		**38**
Route 302				
Thru-routes		0		16
Other	10	15	.	24
Subtotal	10	15	5	40
Route 304.1				
Thru-routes		16	8	22
Other	.	2	.	.
Subtotal	7	18	8	22
Route 304.0	7	17	5	40
•Subtotal Route 304	4	35	3	62
Route 305	10	25	15	16
•Subtotal-Express		**75**		**118**
Total-Local & Express		**112**		**156**
MID-DAY (Base and School)				
Route 53	60	15	60	15
Route 54	60	14	--	0
Route 56	60	17	60	15
Route 58	60	15	60	15
Route 59	30	32	60	15
•Subtotal-Local		**93**		**60**

routed local routes, where one unlinked trip on Route 305 becomes two unlinked trips - one on the local route and one on the express route with which the local route is through-routed.

[71]Peak Direction

Table 12-4 (Cont.)
Service Statistics -
Existing Service Compared to Integrated Service

	Existing Service		Integrated Service	
	Average Headways	One-Way Trips	Average Headways	One-Way Trips.
MID-DAY (Continued)				
Route 302				
Thru-routes	0	30		31
Other	30	31	.	0
Subtotal	30	31	30	31
Route 304.1	30	31	30	31
Route 304.0	30	39	.	10
•Subtotal Route 304	15	70	30	41
Route 305	.	14	.	12
•Subtotal-Express		**115**		**84**
Total-Local & Express		**208**		**144**
PM PEAK				
Route 53	60	5	15	14
Route 54	60	4	--	0
Route 56	45	5	30	8
Route 58	34	5	30	6
Route 59	21	14	30	9
•Subtotal-Local		**33**		**37**
Route 302				
Thru-routes		0		15
Other	12	16	.	14
Subtotal	12	16	12	29
Route 304.1	10	20	10	22
Route 304.0	9	30	12	27
Subtotal Route 304		50		49
Route 305	10	22	15	15
•Subtotal-Express		**88**		**93**
Total Local & Express		**121**		**130**
TOTAL- AM Peak thru PM Peak:				
Local:		**163**		**135**
Express:		**278**		**295**
Total:		**441**		**430**

Including the additional passenger revenue that would be generated by new riders, the integration of service would reduce the operating deficit by $289,400 per year.

Most of the ridership increase would be due to the extension of Route 302 to Federal and Franklin Streets that would be implemented in conjunction with improved service integration. However, while that extension could also be implemented without better integration of Routes 53, 56, 58, 34 and 305 as well, vehicle requirements would be higher. With a Route 302 extension alone, vehicle requirements would increase by four, while with improved integration of all services, the increase in the number of vehicles required would be reduced to two.

Ridership Impacts, by Route

Of the total increase of 620 linked trips, the Route 302 extension would be responsible for 81 percent, or 505 trips, while 19 percent, or an increase of 115 trips, would be attributable to the improved service integration. Overall, Route 302 ridership would increase by 123 percent, or 1,635 trips, to 2,965 trips per day. As shown in Table 12-5, 1,495 trips of this increase would be trips attracted by the extension of service or would be ex-Route 304 mid-day riders, while 140 would be attracted by the increase in through-routed service or would have shifted from Route 305.

While Route 302 ridership would more than double, total ridership on Route 304 and 305 would decrease by 820 trips per day, or 16 percent. On Route 304, all of the loss would be due to the shift of mid-day riders from Route 304.0 to Route 302, and a shift of riders during peak periods that would be better served by extended Route 302 service. On Route 305, nearly all of the decrease would be due to the shifting of current riders to through-routed local routes.

On local routes, the improved integration of service, increased peak period service and an increased number of through-routings to Boston would attract a total of 305 new trips. However, the elimination or reduction of unproductive local service would offset much of the increase. The combination of Routes 54 and 58, including 60 minute mid-day service between Waltham Center and Newton Corner along Route 53, and the elimination of Route 59.1 service would result in the loss of up to 165 trips per day. As a result, the net gain in ridership on local routes would be 140 linked trips per day.

Table 12-5
Ridership Impacts of Improved Integration of Local and Express Services (All Day)

	Route							
	53	54	56	58	59	302	304	305
Current Ridership	830	650	580	390	1,170	1,330	2,830	1,440
Change due to:								
•Combine Routes 54 and 58	325	-650	--	85	--	--	--	--
•30 Min Peak Per, Peak Dir Hdwys	--	--	40	45	0	--	--	--
•60 Min Mid-day Hdwys	--	--	0	0	-65	--	--	--
•Increased Thru-Routings	0	--	25	0	65	65	25	--
•Rt 302 Extension	--	--	--	--	--	875	-190	--
•Elimination of Rt 304.0 Mid-day	--	--	--	--	--	615	-705	--
•Elimination of Rt 59.1	--	--	--	--	-45	--	--	--
•Wal Ctr Coord	360	--	140	80	--	80	500	-450
•Total Change	685	-650	205	210	-45	1,635	-370	-450
Projected Ridership w/Changes	**1,515**	**0**	**785**	**600**	**1,125**	**2,965**	**2,460**	**990**

Impact on Operating Deficit/Vehicle Requirements

As previously mentioned, there would be an increase in the amount of service provided in both peak periods, and a decrease in mid-day service. As a result, operating costs and vehicle requirements during both peak periods would increase. However, as further discussed below, service levels would be reduced during the mid-day, and the reduction in mid-day operating costs would offset the increases in peak period operating costs.

Operating Costs/Revenues On an all day basis, operating costs would be reduced by $108,100 per year, and the operating deficit would be reduced by $289,400 per year. (By comparison, an extension of Route 302 without also coordinating other services would reduce the operating deficit by $31,600.) As shown in Table 12-6, most of the savings would be due to the consolidation of Routes 54 and 58, and the elimination of the Route 59.1 variation of Route 59.

Table 12-6
Annual Financial Impacts of Integrated Service

	Change in Operating Costs	Change in Weekday Ridership	Change in Fare Revenue	Change in Operating Deficit.
Route 53	$117,300	685	$59,938	($57,363)
Route 54	($188,900)	-650	($52,000)	($136,900)
Route 56	$5,500	205	$16,400	$10,900
Route 58	$12,300	210	$18,900	$6,600
Route 59	($124,200)	-45	($4,838)	($119,363)
Route 302	$266,300	1,635	$327,000	$60,700
Route 304	($35,700)	-370	($74,925)	$39,225
Route 305	($160,600)	-450	($109,125)	($51,475)
Total	**($108,000)**	**1220**	**$181,350**	**$289,350**

Vehicle Requirements Currently, 39 vehicles are deployed in the AM peak to provide service on Routes 53, 54, 56, 58, 59, 302, 304, and 305. With integrated services, based upon the sample AM peak schedule in Figure 12-2, 41 vehicles would be required (see Table 12-7).

Table 12-7
AM Peak Vehicle Requirements with Integrated Service

	Vehicle Requirement
Route 53/304.1	7
Route 56/304.1	3
Route 58/302	4
Route 59/302	4
Other Route 302	5
Route 304.0	13
Route 305	5
Total:	**41**

Due to the extensive interlining included in present schedules, it is difficult to directly compare the vehicle requirements shown in Table 12-7 with current vehicle requirements on a route by route basis. However, on an overall basis, the vehicle requirement for through-routed local service would

increase by two, while for other express service, the total would remain the same.

13. Summary/ Recommendations

In general, the West Corridor is an area that is difficult to serve with transit. With the exception of downtown Boston, there are no concentrated locations within or near the WESTBus area that attract enough trips to support high levels of transit service, and there is a very low level of transit dependency. As a result, the transit dependent population comprises a very low transit base, and on local routes, low levels of service discourage most others from using transit.

To downtown Boston, where there is a large concentration of trips from the WESTBus area, the express routes are successful in attracting a large number of trips. These routes, in contrast to local routes, serve very few transit dependent riders, and instead attract "choice" riders. Most peak period, peak direction express trips are at, close to, or exceed seated capacity, but mid-day and non peak direction service is lightly utilized. As a result, the overall utilization of these routes, in terms of passengers per vehicle mile or per vehicle hour, is relatively low. However, since there are few transit dependent riders, average fares are high, and the express routes recover approximately 60 to 90 percent of their operating costs.

Although the number of trips made from the WESTBus area to downtown Boston will decline in relation to the total number of trips made from the WESTBus area, they will continue to increase in absolute numbers. For the foreseeable future, this market will continue to be the source of most WESTBus ridership, and also holds the potential for the most significant ridership increases. In general terms, the most significant potential improvements or necessary changes with respect to individual express routes are the following:

- An increase in peak period service on Routes 304 and 305 to relieve crowding problems.

- An increase in peak period cycle times on Route 301 and 305 to improve reliability.

- An extension of Route 302 to Federal and Franklin Streets via Park Square to serve demand to the Park Square area. This extension will also allow for the elimination of mid-day Route 304.0 service.

For trips to other areas, due to the scattered nature of trip attractors and generators, large increases in local ridership cannot be attained in a cost effective manner. As a result, the major function of local routes will continue to be that of providing a basic level of service within the WESTBus area. As listed in Table 13-1, there are a number of changes that can be made to the local routes that would increase the efficiency of the individual routes. In general, most of these changes would reduce the cost of the existing service, but most would also result in ridership losses as well.

Alternatively, a more comprehensive set of adjustments including changes to local routes, increased through-routing with express routes, and improved coordination between local and express routes could reduce costs while also increasing ridership. These changes, as described in previous chapters and summarized below, would revise the existing system to shift many of the trips now made on Route 305 to local trips with excess capacity, and to through-route these trips to Boston. Since through-routed local trips provide similar travel times between Waltham Center and downtown Boston as Route 305, Route 305 riders could then be shifted to these trips without a degradation in service. The increased utilization of the local routes would then reduce the overall amount of service that must be provided to serve existing and projected demand. Impacts would be as follows:

- In conjunction with an extension of Route 302 to Federal and Franklin Streets via Park Square, overall ridership would increase by up to 1,220 unlinked trips per day, or eight percent. At the same time, operating costs would be reduced by $108,000, and including the new revenue generated by the increased ridership, the operating deficit would decrease by $289,400, or by six percent for the WESTBus services.

- The shifting of Route 305 riders to through-routed local trips would require that headways on local routes operating through Waltham Center be reduced to 15 to 30 minutes. These headway reductions would benefit local riders as well as express riders and would not be feasible without the shifting of Route 305 riders to these routes.

- An increase in the number of peak period trips through Waltham Center. To and from Boston, the increase would be from 163 to 211 daily one-way trips, and on local routes, there would be an increase from 70 to 75 trips.

- Increases in peak period service between downtown Boston and Newton Corner and Watertown Square. From Newton Corner, including Route 302 trips, there would be an increase from 125 trips to 167 trips; from Watertown Square, the increase would be from 163 trips to 211 trips per day.

Table 13-1
Impacts of Potential Changes, by Route

	Annual Impact of Weekday Changes							
	New Pax Trips	Pax Trips Lost	Net Change	Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost per Pax Trip	Impact on AM Pk Vehicle Reqmt
Route 52 (Chapter 3)								
•Thru-Rt with Rt 304.1	270	170	100	($28,300)	$10,800	($39,100)	($1.56)	None
•Eliminate Community Center variations	65	60	5	($9,600)	($500)	($9,100)	($7.28)	None
•Eliminate Dedham Mall variation	0	120	-120	($40,800)	($12,900)	($27,900)	($0.93)	None
•15 min peak period hdways	220	0	220	$190,000	$23,700	$166,300	$3.02	+3
•45 min peak period hdways	0	100	-100	($45,000)	($10,800)	($34,200)	($1.37)	-1
•45 min base hdways	0	60	-60	($59,000)	($6,500)	($52,500)	($3.50)	None
Routes 53 & 54 (Chapter 4)								
•Replace Routes 53 and 54 with Routes "A" & "B"	210	100	110	$18,100	$9,400	$8,700	$0.32	None
•Combine inner end of Rt 58 w/ outer end of Route 53	0	140	-140	($85,000)	($11,900)	($73,100)	($2.09)	None
•Combine inner end of Rt 58 w/ outer end of Route 54	0	140	-140	($88,000)	($11,900)	($76,100)	($2.17)	None
•Rt 54 via Corp of Eng/ Trapelo Rd Hospital Area	230	70	160	$800	$13,600	($12,800)	($0.32)	None
•60 Min AM peak headways								
Route 53	0	-40	40	($15,300)	($3,400)	($11,900)	($1.19)	-1
Route 54	0	-20	20	($15,000)	($3,400)	($11,600)	($2.32)	-1
•40 Min PM peak headways								
Route 53	10	0	10	$0	$850	($850)	($0.34)	None
Route 54	5	0	5	$0	$429	($429)	($0.34)	None
•40 Min PM peak headways								
Route 53	55	0	55	$14,700	$4,675	$10,025	$0.73	None
Route 54	50	0	50	$15,100	$4,290	$10,810	$0.86	None

Table 13-1 (Continued)
Impacts of Potential Changes, by Route

	New Pax Trips	Pax Trips Lost	Net Change	Annual Impact of Weekday Changes: Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost per Pax Trip	Impact on AM Pk Vehicle Reqmt
Route 56 (Chapter 5)								
•Operate Rt 56.1 trips as Route 56.0 trips	25	5	20	$0	$1,800	($1,800)	($0.36)	None
•Thru-rt all trips w/ Rt 304.1	25	0	25	$0	$2,250	($2,250)	($0.36)	None
•60 min AM peak headways	0	45	-45	($11,000)	($4,100)	($6,900)	($0.61)	-1
•30 min PM peak headways	70	0	70	$5,500	$6,300	($800)	($0.05)	None
•Eliminate 3:00 PM inb trip	0	1	-1	($5,500)	($90)	($5,410)	($21.64)	None
Route 58 (Chapter 6)								
•Eliminate Rt 58 beyond Wal Ctr	0	115	-115	($83,400)	($10,500)	($72,900)	($2.54)	-1
•Eliminate Rt 58 beyond Wal Ctr and thru-rt with Rt 305 at Wal Ctr	0	65	-65	($83,400)	($5,900)	($77,500)	($4.77)	-1
•Eliminate Rt 58 beyond Wal Ctr and thru-rt with Rt "A" at Wal Ctr	0	85	-85	($83,400)	($7,700)	($75,700)	($3.56)	-1
•Thru-rt all trips with Rt 304.1	20	0	20	$0	$1,800	($1,800)	($0.36)	
•New Route "C"	340	0	340	$173,500	$30,900	$142,600	$1.67	+1
•Relocate inner terminal to Watertown Sq and thru-route all trips with Route 304.0	50	20	30	$0	$2,700	($2,700)	($0.36)	None
•60 min peak headways	0	30	-30	($17,500)	($2,700)	($14,800)	($1.97)	-1
Route 59 (Chapter 7)								
•Eliminate Rt 59.1 variation	0	135	-135	($331,500)	($14,500)	($317,000)	($9.39)	None
•Thru-rt all trips with Rt 302	65	0	65	$0	$7,000	($7,000)	($0.43)	None
•Thru-rt all trips with Rt 304.0	65	0	65	$0	$7,000	($7,000)	($0.43)	None

Table 13-1 (Continued)
Impacts of Potential Changes, by Route

	New Pax Trips	Pax Trips Lost	Net Change	Annual Impact of Weekday Changes: Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost per Pax Trip	Impact on AM Pk Vehicle Reqmt
Route 300 (Chapter 8)								
•Variation via West Newton	170	30	140	$5,300	$42,000	($36,700)	($1.05)	+1
•Variation via Newton Corner	240	50	190	$11,200	$57,000	($45,800)	($0.96)	+1
•New Service to Park Square	160	0	160	$207,900	$48,000	$159,900	$4.00	+2
•New Service to Park Street	200	0	200	$215,900	$60,000	$155,900	$3.12	+2
•New Service to Federal/Franklin	160	0	160	$214,700	$48,000	$166,700	$4.17	+2
•7.5 - 15 min PM peak headways	0	20	-20	($45,200)	($6,000)	($39,200)	($7.84)	None
Route 301 (Chapter 9)								
•Operate Service via Park Square	205	170	35	$0	$6,700	($6,700)	($0.77)	
•Increase AM peak cycle time to solve reliability problems	0	0	0	$10,800	$0	$10,800	NA	+1
•Increase PM peak cycle time to solve reliability problems	0	0	0	$37,400	$0	$37,400	NA	None
•Add inbound trip at 8:08 AM to reduce crowding	0	0	0	$5,800	$0	$5,800	NA	None
Routes 302 and 304 (Chapter 10)								
•Extend Rt 302 to Park Square	385	0	385	$119,600	$81,300	$38,300	$0.40	+2
•Extend Rt 302 to Fed/Franklin; Eliminate Rt 304 mid-day	685	90	595	$94,900	$126,500	($31,600)	($0.21)	+3
•Extend Rt 302 to Park Street; Eliminate Rt 304 mid-day	675	220	0 455	$100,400	$97,700	$2,700	$0.02	+3
•Extend all Rt 304.0 trips to Waverley Square	230	0	230	$211,800	$37,700	$174,100	$3.03	+3
•Extend Rt 304.0 trips to Waverley at 30 minutes peak, 60 minutes off-peak	130	0	130	$55,400	$21,300	$34,100	$1.05	+1

Table 13-1 (Continued)
Impacts of Potential Changes, by Route

				Annual Impact of Weekday Changes				
	New Pax Trips	Pax Trips Lost	Net Change	Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost per Pax Trip	Impact on AM Pk Vehicle Reqmt
Routes 302 and 304, Continued (Chapter 10)								
•Add two trips in AM peak half-hour on Rt 304.0 to reduce crowding	0	0	0	$24,900	$0	$24,900	NA	+1
•Add one trip in PM peak half-hour on Route 304.0 to reduce crowding	0	0	0	$12,400	$0	$12,400	NA	None
•Eliminate Route 304.1 mid-day	0	135	-135	($169,000)	($27,400)	($141,600)	($4.20)	None
Route 305 (Chapter 11)								
•Integrate Route 305 service with thru-routed local routes	230	90	140	$29,800	$52,500	($22,700)	($0.65)	-2
•Add two AM peak trips to provide all passengers with a seat	0	0	0	$35,700	$0	$35,700	NA	+1
•Increase PM peak cycle time fr 80 to 90 minutes to improve reliability	0	0	0	$14,600	$0	$14,600	NA	None
Improved Integration of Local and Express Services (Chapter 12)								
•Integrate local and express service at Wal Ctr, Newton Cnr & Wat Sq	1,450	230	1,220	($108,000)	$181,350	($289,350)	($0.95)	+2

- Including changes to Routes 52, 300 and 301, AM peak vehicle requirements would increase by one. Without the integration of local and express services, but with an extension of Route 302 to Park Square and additional service on Routes 304 and 305 to reduce crowding, vehicle requirements would increase by three.

COORDINATION OF SERVICE AT WALTHAM CENTER/INCREASED USE OF LOCAL SERVICE TO CARRY TRIPS TO AND FROM BOSTON

To maximize cost savings and ridership gains, all local routes operating through Waltham Center should be through-routed to Boston and coordinated with Route 305 at Waltham Center. Since all Waltham local routes now terminate at Newton Corner and nearly all Route 304.1 trips at Newton Corner are already through-routed with a local trip, changes to some local routes would be needed in order to increase the amount of through-routing. These changes would be as follows:

Route 53:

- *No change to basic alignment. Through-route all trips with Route 304.1 at Newton Corner.*

- *Operate Route 53 at 15 minute peak period headways, 60 minute mid-day headways.*

  With the elimination of Route 54 (as described below), Route 53 headways would need to be reduced during peak periods to replace Route 54 service between Newton Corner and Waltham Center. During the mid-day, 60 minute headways would be sufficient to carry all of the trips now carried on both Route 53 and 54 along the same segment. (See also Chapters 4 and 12.)

Routes 54 and 58:

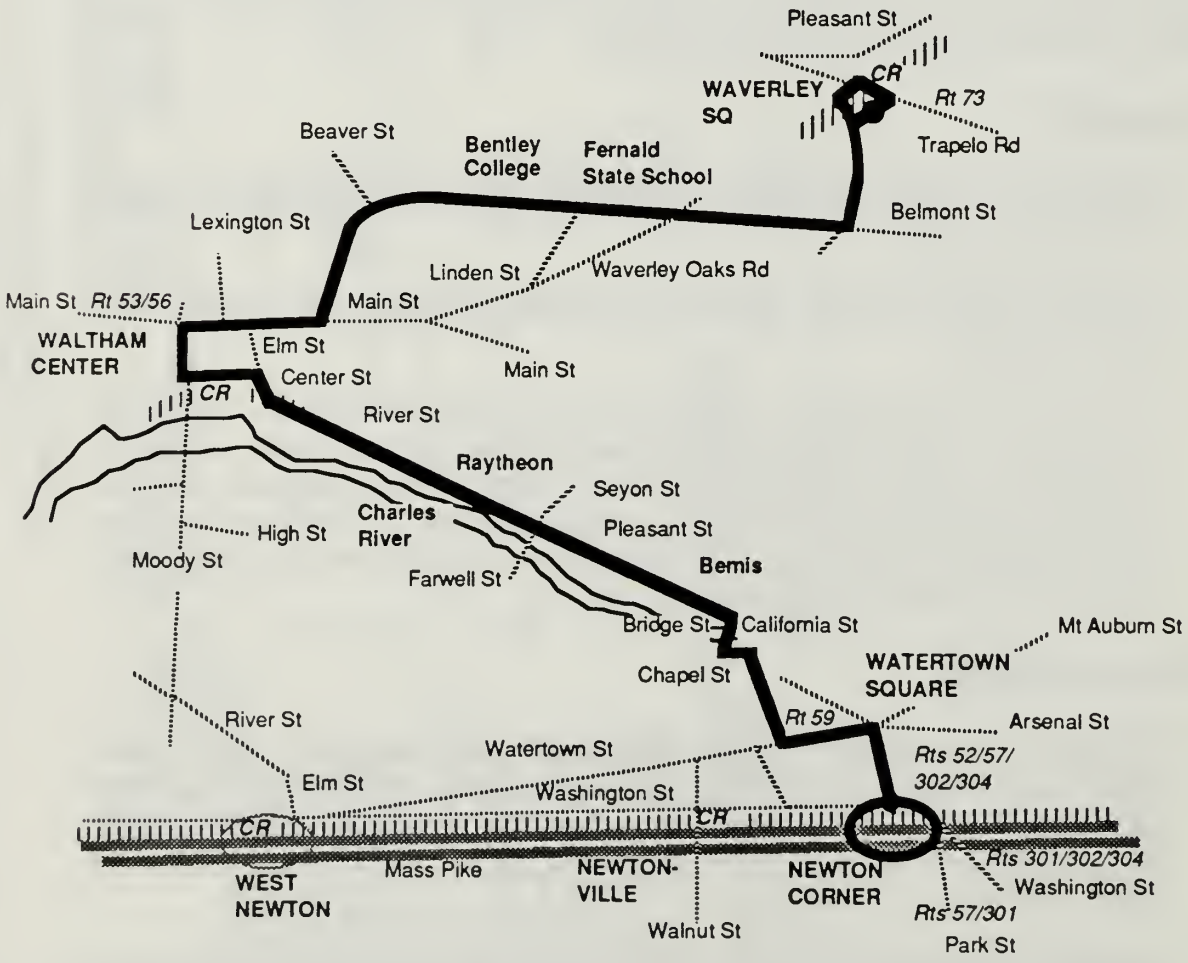
- *Combine outer segment of Route 54 beyond Waltham Center with inner segment of Route 58 (between Waltham Center and Newton Corner) (see Figure 13-1). Eliminate Route 54 service between Waltham Center and Newton Corner and Route 58 service between Waltham Center and Auburndale.*

- *Reroute the inner terminal of Route 58 from Newton Corner to Watertown Square to allow all trips to be through-routed with Route 302.*

- *Operate revised route at 30 minute peak period headways; 60 minutes mid-day.*

These changes would combine two current routes into one route and allow all trips to be through routed to Boston. The new route (called Route 58 for these purposes) would operate between Watertown Square along Watertown Street to Chapel Street, where it would follow the current alignment of Route 58 to Waltham Center, and then the existing alignment of Route 54 from there to Waverley Square. Unproductive service along the outer end of Route 58 (between

Figure 13-1
Combination of Inner End of Route 58
and Outer End of Route 54, including
Relocation of Inner Terminal to Watertown Square



Waltham Center and Auburndale) would be eliminated, but most existing riders would still be within one-quarter of a mile of other service on Routes 53 and 305. Along the existing inner end of Route 54, equivalent service would be provided by Route 53, which follows the same alignment. (See also Chapters 4, 6, 11 and 12.)

Route 56:

- *Operate all trips as Route 56.0. Through-route all trips with Route 304.1 at Newton Corner.*

- *Operate route at 30 minute peak period headways; 60 minutes mid-day.*

The Route 56.1 variation carries only five trips per day to and from Cedarwood. These same trips could be used more productively as Route 56.0 trips. (See also Chapters 5, 11, and 12.)

Route 302:

- *Extend Route 302 from Copley Square to Federal and Franklin Streets via Park Square along the alignment previously used by Route 310.*

- *Eliminate the loop around the Prudential Center.*

An extension of Route 302 would increase ridership by 595 trips per day and allow for the elimination of mid-day Route 304.0 service. With the elimination of the loop around the Prudential Center, local trips through-routed with Route 302 could provide comparable service between downtown Boston and Waltham Center in terms of travel time, which would be necessary to avoid uneven loads on other trips to and from Waltham Center. (See also Chapters 10 and 12.)

Route 305

- *Increase peak period headways from 10 to 15 minutes.*

With the through-routing of the local routes and the coordination of services at Waltham Center, up to 290 peak period trips would shift from Route 305 to through-routed local trips on Routes 53, 56 and 58. This would allow Route 305 headways to be increased to 15 minutes. This would result in a decrease in the number of peak direction trips from 15 to 9 in the AM peak, and from 14 to 9 in the PM peak. (See also Chapter 11.)

As described in Chapter 12, Routes 53, 56, 58 and 305 should then be scheduled to provide service to downtown Boston at five minute intervals. A typical sequence of trips from Waltham Center (at five minute intervals) would be Route 305, 58/302, 53/304.1, 305, 56/304.1, 53/304.1, 305, 58/302, and so forth.

IMPROVED SERVICE FROM NEWTON CORNER/WATERTOWN SQUARE

With the increased use of through-routed local trips from Waltham, the increased number of passengers already on-board buses as they arrive at Newton Corner or Watertown Square would leave less room on board for those that now board at those locations. In addition, the extension of Route 302 to Federal and Franklin Streets would also increase loads. To handle these increased loads, it would be necessary to provide additional service on Routes 302 and 304. In addition, all Route 59 trips would also be through-routed to Boston (via Route 302). These changes would be as follows:

Route 59:

- *Eliminate the Route 59.1 variation.*

- *Through-route all Route 59.0 service with Route 302 at Watertown Square with Route 302.*

- *Operate Route 59.0 at 30 minute peak period headways, and 60 minute mid-day headways.*

Ridership on the Route 59.1 variation is extremely low, carrying only 45 trips per day past Newton Highlands. Route 59.0 at existing service levels can accommodate the 155 riders that use the portion of Route 59.1 between Newton Highlands and Watertown Square. (See also Chapters 7 and 12.)

Route 302

In addition to the changes described in the previous section:

- *Increase the number of AM inbound trips from 11 to 22, with 19 operating at seven to eight minute headways throughout the period, and an additional three trips added during the peak half hour. Four of the 22 trips would be through-routed with Route 58 and four would be through-routed with Route 59.*

- *During the mid-day, return Route 302 to 30 minute headways.*

- *During the PM peak, increase the number of outbound trips from nine to 16. Headways would average eight to nine minutes using the schedule shown in Chapter 12 in Figure 12-3.*

  During the AM and PM peaks, the additional trips would be needed to carry increased loads to and from the through-routed trips and Park Square. During the mid-day, thirty minute headways would be needed to carry ridership to Park Square and those trips now carried on Route 304.0, which would be eliminated. (See also Chapters 10 and 12.)

Route 304.0

- *Increase the number of AM peak inbound trips from 17 to 22, with Route 304.0 trips departing from Watertown Square at the same time as Route 302 trips.*

- *Eliminate Route 304.0 service between 9:10 AM and 3:40 PM.*

- *Continue to operate 15 outbound trips in the PM peak.*

  To prevent overcrowding on Route 302 trips, it would be necessary to operate peak period Route 304.0 trips on the same peak direction schedule as Route 302. Therefore, to a large extent, Route 302 service levels would govern Route 304.0 service levels. The one exception would be a 4:55 PM outbound Route 302 departure that would not be matched with a Route 304.1 departure.

  During the mid-day, the elimination of Route 304.0 service would be possible due to the extension of Route 302 to Federal and Franklin Streets. All current mid-day Route 304.0 would be served instead by Route 302.

  (See also Chapters 10 and 12, including Figures 12-2 and 12-3.)

Route 304.1

- *Increase the number of inbound trips in the AM peak from 10 to 13.*

- *Continue to operate mid-day service at 30 minute headways. Alternate these trips with Route 302 trips, (which would also operate at 30 minute headways).*

- *Increase the number of outbound departures from 13 to 14.*

  All Route 304.1 trips throughout the day would be through-routed with a Route 53 or Route 56 trip. Schedules would be coordinated in

both Waltham Center and Newton Corner. (See also Chapters 11 and 12, including Figures 11-2, 12-2 and 12-3.)

With these changes, a higher level of service would be provided during peak periods on most local services, and between Waltham Center, Newton Corner, Watertown Square and Boston. Between Waltham Center and Boston, service would be provided in the peak direction at five minute headways in both peak periods. To and from Watertown Square, headways would be five minutes in the AM peak and eight minutes in the PM peak. To and from Newton Corner, headways would be three to four minutes in both peak periods.

Although there would be increases in peak period service, including large increases on Routes 302 and 304.0, overall costs would decline due to a reduction in mid-day service, including the elimination of Routes 54 and 59.1, and mid-day service on Route 304.0. Total operating costs would be reduced by $108,100 per year, while fare revenue would increase by $181,400. The operating deficit would decrease by $289,400 per year.

OTHER ROUTE CHANGES

Routes 52, 300 and 301 would be unaffected by the above changes. However, as listed below, a number of changes are warranted on these routes as well:

Route 52

- *Eliminate the Community Center variations (52.6 and 52.7)*
- *Increase mid-day headways from 30 minutes to 45 minutes.*

On the Community Center variations, twenty-one daily bus trips are used by only 30 persons per day. These variations also increase the complexity of the route, increase headways or trip times for passengers traveling on the major variations of the route beyond Newton Centre, and require that 30 minute headways be provided during the mid-day, which is more service than demand warrants.

The elimination of these variations would allow the overall level of service provided on Route 52 to be reduced. During the PM peak, the Community Center variations should be replaced by Route 52.1 trips to serve demand along the trunk portion of the route, but during the mid-day, a lower level of service could be provided. Currently, during the mid-day, Route 52.1 and 52.7 trips both operate at 60 minute headways and alternate trips. With the elimination of Route 52.7,

Route 52.1 should operate at 45 minute headways. These changes would reduce the operating deficit by approximately $60,000 per year and require one fewer vehicle during the base and school periods. (See also Chapter 3.)

Route 300

- *Increase PM peak headways between 4:40 PM and 5:45 PM from an average of 6 minutes to 7.5 minutes, and before and after that time from 10 to 15 minutes.*

In the PM peak, peak loads average only 29 throughout the period, and 38 in the peak half-hour. As a result, headways could be increased without forcing passengers to stand. The headway increases described above would save $46,200 per year and require two fewer buses.

Route 301

- *Add an inbound trip at 8:08 AM to relieve crowding.*

- *Operate Route 301.1 trips as Route 301.0*

During the AM peak, inbound trips depart at four minute intervals except for an eight minute gap between 8:04 AM and 8:12 AM. The eight minute gap results in loads of approximately 74 passengers on the 8:12 AM trip.

Route 301.1 trips, which operate only during the afternoon, travel inbound from Brighton Center via Newton Corner. Ridership on all inbound trips is very low, at less than four passengers per trip, and these passengers are also served by Route 301.0 service, which operates inbound via Union Square. Since the outbound trips are needed, Route 301.1 trips could not be eliminated, but fewer vehicles would be required by operating these trips instead as Route 301.0.

Further, Route 301 experiences reliability problems in both peak periods due to insufficient cycle times. With the continuation of the current routings, necessary increases in cycle times would increase operating costs by $48,200 and increase vehicle requirements by one in the AM peak and by two in the PM peak. Operation of all Route 301.0 and 301.1 trips as 301.0 trips would solve reliability problems without increasing operating costs or vehicle requirements.

(See also Chapter 7.)

Most of the changes discussed above could be implemented in either of two ways: (1) to minimize disruption to the existing system and travel patterns, or (2) to maximize benefits in terms of increased ridership and reduced operating costs. The first would involve more modest changes that would be easier to implement, at a cost of sacrificing maximum benefits. The second would achieve the greatest benefit to most existing riders and generate new ridership while reducing operating costs, but would also involve changes to existing travel habits, and leave some existing riders unserved. Therefore, a phased implementation of the changes may be desirable. The changes that would be easiest to implement are listed in Table 13-2 as "Phase I Improvements"; the more significant changes follow those and are listed as "Phase II Improvements" in Table 13-3.

In total, Phase I changes would increase ridership by 830 trips per weekday, or 5.4 percent, while at the same time reducing annual operating costs by $247,700 and the operating deficit by $427,240. AM peak vehicle requirements would increase by two. Phase II changes would decrease operating costs by another $322,600 and attract an additional 985 daily passangers beyond those possible in Phase I. Including the additional revenue generated by these new riders, the operating deficit could be reduced by an additional $408,410. Phase I and Phase II improvements combined would reduce total operating costs by $570,300 per year, increase fare revenue by $265,350 and reduce the operating deficit would decrease by $835,650 per year. AM peak vehicle requirements would increase by two.

Table 13-2
Summary of Phase I Changes

	New Pax Trips	Pax Trips Lost	Net Change	Annual Impact of Weekday Changes: Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost/ New Pax	Net Savings/ Pax Lost	Impact on AM Pk Veh Reqmt
PHASE I CHANGES									
Route 52 (Charles River Loop/Dedham Mall - Watertown Square)									
•Eliminate Community Center variations	65	60	5	($9,600)	($500)	($9,100)	($7.28)	NA	None
•45 min base hdways	0	60	-60	($59,000)	($6,500)	($52,500)	NA	$3.50	None
•Overall Impact	65	120	-55	($68,600)	($7,000)	($61,600)	NA	$4.48	None
Route 53 (Brandeis/Roberts - Newton Corner) and Route 54 (Waverly Square - Newton Corner)									
•40 Min PM peak headways									
Route 53	10	0	10	$0	$850	($850)	($0.34)	NA	None
Route 54	5	0	5	$0	$429	($429)	($0.34)	NA	None
•40 Min PM peak headways									
Route 53	55	0	55	$14,700	$4,675	$10,025	$0.73	NA	None
Route 54	50	0	50	$15,100	$4,290	$10,810	$0.86	NA	None
•Overall Impact	120	0	120	$29,800	$10,244	$19,556	$0.65	NA	None
Route 56 (Newton Highlands - Newton Corner)									
•Operate Rt 56.1 trips as Route 56.0 trips	25	5	20	$0	$1,800	($1,800)	($0.36)	NA	None
•Eliminate 3:00 PM inbound trip	0	0	0	($5,500)	$0	($5,500)	NA	NA	None
•30 Min PM peak headways	70	0	70	$5,500	$6,300	($800)	($0.05)	NA	None
•Overall Impact	95	5	90	$0	$8,100	($8,100)	($0.36)	NA	None
Route 58 (Auburndale - Newton Corner)									
•Relocate inner terminal to Watertown Sq and thru-route all trips with Route 304.0	50	20	30	$0	$2,700	($2,700)	($0.36)	NA	None
•Overall Impact	50	20	30	$0	$2,700	($2,700)	($0.36)	NA	None
Route 59 (Needham Junction - Watertown Square)									
•Eliminate Rt 59.1 variation	0	135	-135	($331,500)	($14,500)	($317,000)	NA	$9.39	None
•Thru-rt all trips with Rt 302	65	0	65	$0	$7,000	($7,000)	($0.43)	NA	None
•Overall Impact	65	135	-70	($331,500)	($7,500)	($324,000)	NA	$18.51	None
Route 300 (Riverside - Downtown Boston)									
•7.5 - 15 min PM peak headways	0	20	-20	($45,200)	($6,000)	($39,200)	NA	$7.84	None
•Overall Impact	0	20	-20	($45,200)	($6,000)	($39,200)	NA	$7.84	None
Route 301 (Brighton Center - Downtown Boston)									
•Add inbound trip at 8:08 AM to reduce crowding	0	0	0	$5,800	$0	$5,800	NA	NA	None
•Overall Impact	0	0	0	$5,800	$0	$5,800	NA	NA	None

Table 13-2 (cont.)
Summary of Phase I Changes

				Annual Impact of Weekday Changes					
	New Pax Trips	Pax Trips Lost	Net Change	Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost/ New Pax	Net Savings/ Pax Lost	Impact on AM Pk Veh Reqmt
Route 302 (Watertown Square - Copley Square) and									
Route 304 (Newton Corner/Watertown Square - Downtown Boston)									
•Extend Rt 302 to Fed/Franklin; Eliminate Rt 304 mid-day	685	90	595	$94,900	$126,500	($31,600)	($0.21)	NA	+3
•Add two trips in AM peak half-hour on Rt 304.0 to reduce crowding	0	0	0	$24,900	$0	$24,900	NA	NA	+1
•Add one trip in PM peak half-hour on Route 304.0 to reduce crowding	0	0	0	$12,400	$0	$12,400	NA	NA	None
•Overall Impact	685	90	595	$132,200	$126,500	$5,700	$0.04	NA	+4
Route 305 (Waltham Center - Downtown Boston)									
•Integrate Route 305 service with thru-routed local routes	230	90	140	$29,800	$52,500	($22,700)	($0.65)	NA	-2
•Overall Impact	230	90	140	$29,800	$52,500	($22,700)	($0.65)	NA	-2
TOTAL PHASE I IMPACTS	**1,310**	**480**	**830**	**($247,700)**	**$179,544**	**($427,244)**	**($2.06)**	**NA**	**+2**

Table 13-3
Summary of Phase II Changes

			Annual Impact of Weekday Changes						
	New Pax Trips	Pax Trips Lost	Net Change	Impact on Oper Costs	Impact on Oper Rev	Impact on Oper Deficit	Net Cost/ New Pax	Net Savings/ Pax Lost	Impact on AM Pk Veh Reqmt
PHASE II CHANGES (Impacts over and above those of Phase I)									
Route 53 (Brandeis/Roberts - Newton Corner) and Route 54 (Waverly Square - Newton Corner)									
•15 min peak period hdwys on Rt 53 to allow for elimination of Rt 54 between Wal Ctr & Newton Cnr	205	0	205	$87,500	$18,156	$105,656	$2.06	NA	+3
•Combine inner end of Rt 58 w/ outer end of Route 54 and eliminate inner end of Rt 54 between Wal Ctr & Newton Cnr (see also Route 58)	0	140	-140	($88,000)	($11,900)	($76,100)	NA	$2.17	-2
•Overall Impact	205	140	65	($500)	$6,256	($6,756)	($0.42)	NA	+1
Route 56 (Waltham Highlands - Newton Corner)									
•Thru-rt all trips w/ Rt 304.1	25	0	25	$0	$2,250	($2,250)	($0.36)	NA	None
•Overall Impact	25	0	25	$0	$2,250	($2,250)	($0.36)	NA	None
Route 58 (Auburndale - Newton Corner)									
•Eliminate Rt 58 beyond Wal Ctr and operate along outer end of Route 54	0	115	-115	($83,400)	($10,500)	($72,900)	NA	$2.54	None
•Overall Impact	0	115	-115	($83,400)	($10,500)	($72,900)	($2.54)	NA	None
Improved Integration of Local and Express Services									
•Integrate local and express service at Wal Ctr, Newton Cnr & Wat Sq (in addition to Rt 53 and 305 changes already described above)	1,150	140	1,010	($238,700)	$87,800	($326,500)	($1.29)	NA	-1
•Overall Impact	1,150	140	1,010	($238,700)	$87,800	($326,500)	($1.29)	NA	-1
TOTAL PHASE II IMPACTS	**1,380**	395	985	**($322,600)**	**$85,806**	**($408,406)**	**($1.66)**	**NA**	**None**
PHASE I + PHASE II IMPACTS	**2,690**	875	**1,815**	**($570,300)**	**$265,350**	**($835,650)**	**($1.84)**	**NA**	**+2**